SCIENCE ABSTRACTS.

Section A.—PHYSICS.

FEBRUARY, 1928.

GENERAL PHYSICS.

230. A Laboratory Instrument for Illustrating Names and Notation for Connections between Dials. T. C. J. Elliott. *Journ. Sci. Instruments,* 4. *pp.* 416–420, *Oct.,* 1927.

A simple laboratory instrument is described for teaching the principles of correspondence between the readings of inter-connected dials; and its uses are indicated. AUTHOR.

231. Surface Tension of Rock-Salt. G. N. Antonoff. *Phil. Mag.* 4. *pp.* 792–800, *Oct.,* 1927.

This paper extends previous work [see Abstract 1982 (1926)] and contains the description of a method for measuring the surface tension of rock-salt based on the preparation of suitable pastes whose surface tensions can be measured by determining the breaking stress of their films. The result obtained of 315 dynes per cm. does not depend on cracks in the crystal and is a measure of the molecular field exercised by the solid. If the molecular solid structure be in doubt the results are not affected thereby. Theoretical considerations indicate that the above figure is correct, and that its difference from the Born value is to be expected from the standpoint previously adopted that molecules must be highly associated in the solid state. H. H. Ho.

232. Contact of Flat Surfaces. F. H. Rolt and H. Barrell. *Roy. Soc., Proc.* 116. *pp.* 401–425, *Oct.* 1, 1927.

The experiments here described show that the thickness of "wringing" films of paraffin oil between flat, polished surfaces of steel and glass is $0\cdot005\,\mu$, which is somewhat less than the limiting thickness of free films of a solution of sodium oleate in water as determined by Johonott and Chamberlain [see Abstract 1390 (1910)] and is approximately double the accepted value of the radius of molecular attraction. Lubricants, such as vaseline oil and ordinary lubricating oil, form wringing films between polished surfaces of steel and glass of thicknesses $0\cdot007\,\mu$ and $0\cdot008\,\mu$ respectively, when artificial means of spreading them between the surfaces is applied. The contact between flat surfaces which are wrung together can be repeated with an accuracy of about $0\cdot01$ to $0\cdot02\,\mu$. Owing to the presence of scratches on lapped surfaces, the average thickness of a wringing film between such surfaces, as determined by the area method, does not represent the thickness of the part of the film separating the planes containing the high regions on the surfaces. The interferometer method gives only the value of a quantity which is a function of this separation; the magnitude of this quantity does, however, confirm the results of the area method for polished surfaces. Wringing films of lubricants between lapped surfaces have the same thickness as films of paraffin oil. The lapped surfaces of end-gauges show evidence of wear during repeated wringings. Wear is most rapid when the surfaces are new, and its rate declines as the number of wringings increases. Averaged over a large number of wringings the wear per surface is of molecular dimensions each time a contact is made. On the basis of the above data, qualitative explanations of certain properties of wrung surfaces are formulated. T. H. P.

233. Measurement of Very Fine Quartz Suspension Fibres. G. A. Tomlinson and H. Barrell. *Journ. Sci. Instruments,* 4. *pp.* 410–413, *Oct.,* 1927.

The paper describes two indirect methods of measurement. One is purely mechanical, and involves a measurement of the elastic strain under a known tension, from which the mean cross-section can be found. The other method depends on the observation of certain diffraction phenomena produced in white light. In a set of fibres measured, the diameter varied from $3\cdot3\mu$ to $0\cdot6\mu$. The optical method is found to become unreliable when the diameter falls below about three wave-lengths. AUTHORS.

234. Rigidity of Superconductive Metals. W. J. de Haas and M. Kinoshita. *K. Akad. Amsterdam, Proc.* 30. 5. *pp.* 598–609, 1927.

The object of the experiments was to find whether there is any change, sudden or otherwise, in the elastic constants of superconducting metals in transition from non-superconductive to superconductive state [see Abstract 2686 (1926)]. For this purpose the rigidities of tin and of mercury have been measured at temperatures down to within 2° or 3° of the absolute zero. Tables and graphs are given, showing that the rigidities of both metals remain apparently undisturbed by the change of state into superconductivity. T. B.

235. Photoelastic Properties of Transparent Cubic Crystals. H. B. Maris. *J.O.S.A. and R.S.I.* 15. *pp.* 194–200, *Oct.,* 1927.

The photoelastic coefficients of rock-salt, sylvite and fluorite were measured for the Hg lines 436, 546 and 578 $\mu\mu$ by means of a modified Soleil-Babinet compensator. Compared with glass the coefficient was positive for rock-salt, negative for sylvite, positive for fluorite stressed normal to a cube face and negative for fluorite stressed normal to an octahedral face. For all cases except that of fluorite stressed normal to octahedral faces, relative retardation plotted against stress per cm.^{2} gave a straight line for loads between 10,000 and 20,000 gm.; this line extended cut the axis of relative retardation above zero. Therefore for cubic crystals the relation between photoelastic effects and externally applied force is not the simple direct relation assumed for non-crystalline materials. A. D.

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236. Photoelastic Studies. H. B. Maris. *J.O.S.A. and R.S.I.* 15. *pp.* 203–237, *Oct.*, 1927.

During the past two years photoelastic investigations, *i.e.*, the analysis of stresses in a specimen by means of polarised light transmitted through the specimen, have been carried out by the author under the direction of E. O. Hulburt. The present paper describes the methods of photoelastic analysis, including new ways of measuring both the double refraction and the deformation resulting from stress. The results of investigations of the tensile test specimen, the notched bar, the ship propeller strut and the roller path ring are given. In each case new, although not unexpected, facts concerning strain members have been brought out very simply by the experimental photoelastic method, facts which would be difficult of discovery by a direct mathematical analysis.

AUTHOR.

237. Optical Determination of Axial Stresses in Long Rectangular Plates under Torsion. I. A. Balinkin. *Phys. Rev.* 30. *pp.* 520–526, *Oct.*, 1927.

The use of polarised light is extended to the determination of the distribution and evaluation of the axial stresses in long rectangular plates subjected to torsion. The equation connecting the stresses σ with the distance r from the axis of rotation is

$$\sigma = \frac{1}{2}\frac{E\phi^2}{l^2}\left(r^2 - \frac{h^2}{12}\right),$$

from which it follows that the compression along the central axis is half as large as the tension along the edges. A new photometric method for measuring the stress intensities was employed. As a photometer, a selenium cell with a narrow window was used; and it is suggested that the photoelectric cell may be applied to this purpose with great advantage.

AUTHOR.

238. Determination of the Elastic Moduli of the Piezoelectric Crystal Rochelle Salt by a Statical Method. W. Mandell. *Roy. Soc., Proc.* 116. *pp.* 623–636, *Nov.* 1, 1927.

An experimental investigation of the elastic moduli of Rochelle salt, comprising bending and twisting experiments is detailed. J. S. G. T.

239. Rigidity of Liquids. G. P. Arcay and P. Étienne. *Comptes Rendus*, 185. *pp.* 700–702, *Oct.* 10, 1927.

Schwedoff's work [see Abstract 758 (1901)] which contains an experimental determination of liquid rigidity and a theoretical attempt to connect rigidity with double refraction is first briefly referred to and followed by a reference to the work of Colin and Michaud. The authors' apparatus is the same in principle as that of Schwedoff, but differs in certain details which are now described. Various liquids have been examined, and among them certain oils and collodion have appeared to be non-rigid whilst exhibiting birefringence. The results obtained are opined to be of value in the study of lubrication. H. H. Ho.

240. Mathematical Investigation of the Thrust experienced by a Cylinder in a Current, the Motion being Periodic. J. L. Synge. *Roy. Irish Acad., Proc.* 37. *pp.* 95–109, *June*, 1927.

The thrust experienced by a fixed cylinder immersed in an infinite stream of incompressible inviscid fluid, whose velocity at infinity is constant, is investigated mathematically on the assumption that vortices are formed at the surface of the cylinder and that the motion is periodic. The thrust per unit length of the cylinder is found to be $(\rho kh/\tau) + \{1 - (\pi h/l) \tan h(\pi h/l)\}\rho k^2/2\pi l$, in which l is the distance between consecutive vortices of the same row, h is the perpendicular distance between the rows, τ is the constant periodic time of the components of velocity at any fixed point, and k is the circulation for each vortex. The value is greater than that given by Karman. The author considers that the empirical relation employed by Karman is theoretically invalid. J. S. G. T.

241. Action in Planetary Orbits. W. B. Morton and W. W. Bruce. *Phil. Mag.* 4. *pp.* 788–791, *Oct.*, 1927.

A previous paper [see Abstract 30 (1927)] dealt with the variation of the action arithmetically for the parabolic trajectory under constant gravity between two points at the same level. The present paper extends the work to the case of the path under the law of the inverse square between points at equal distances from the centre of force. The guided paths, like the free ones, are taken to be conics with the centre of force in a focus, and the terminal velocity is kept constant so that the principle of least action is illustrated. H. H. Ho.

242. A Variation Problem. D. Riabouchinsky. *Comptes Rendus*, 185. *pp.* 840–841, *Oct.* 24, 1927.

Extends the results of a previous paper [see Abstract 2802 (1927)] to cyclic motion. W. G. B.

243. A Hydrodynamic Problem. Part III. C. W. Oseen. *Ark. f. Mat. Astron. och Fysik, Stockholm*, 20. *No.* 3. [55 *pp.*] 1927.

In this mathematical paper boundary problems are considered for the general case where the phenomena depend explicitly on the time. §§ 1, 2 and 3 deal with the formal solution of problems for plane boundaries; § 4 examines two applications of Green's methods; §§ 5, 6 and 7 investigate special cases; and § 8 considers the boundary condition for vanishing viscosity. See Abstract 1606 (1927) for Part II. H. H. Ho.

244. Exact Solutions of Hydrodynamic Differential Equations. Part I. C. W. Oseen. *Ark. f. Mat. Astron. och Fysik, Stockholm*, 20. *No.* 14. [24 *pp.*], 1927.

This mathematical paper gives a generalisation of Hamel's investigation (Jahresber. d. deutsch. Mathematikervereinigung, 25. 1916) of spiral motions in viscous liquids. § 1 considers the derivation of the equations of motion for the stationary two-dimensional case, after which §§ 2, 3, 4 and 5 examine special cases, the general case being treated in § 5. The final § 7 gives a proof that the types of motion found are also possible for the case of a vanishing external force. H. H. Ho.

245. Flow of Air behind an Inclined Flat Plate of Infinite Span. A. Fage and F. C. Johansen. *Roy. Soc., Proc.* **116.** *pp.* **170–197,** *Sept.* **1, 1927.**

When a plate is placed in a current of fluid, thin bands of vorticity are generated at the edges, which roll up at a certain distance behind the plate forming a vortex street. A steel plate, 7 ft. long, 6 in. wide, flat in front, cambered at the back and sharp edged, is vertically mounted in the 7-ft. wind-tunnel of the National Physical Laboratory, and tested inclined at 18 angles ranging from 0·15° to 90° in a wind speed of 50 ft. per second. Measurements are made with the aid of a pressure tube provided with 19 holes laid flush in the surface and connected with a Chattock tilting gauge, and by the method of Simmons and Bailey [see Abstract 1241 (1927)]. The vortices are found to pass downward with a frequency which increases as the inclination of the plate decreases, the frequency being proportional to the wind speed at constant inclination. The longitudinal spacing between the vortices decreases as the plate inclination decreases, while the speed of travel of the vortices increases as the inclination decreases. Vorticity is shed from the two edges of the plate at the same rate, which slowly diminishes as the inclination is decreased from 90°; but only part of the vorticity travels downstream in form of individual vortices. The street opens out laterally. Kármán's formula for the resistance of a plate, expressed in terms of the dimensions of the vortex system behind it, gives values in fair agreement with the observed data, whilst the Kirchhoff-Rayleigh formula considerably underestimated the force k_N acting on the plate. A postscript refers to H. Glauert's objection that the wind-tunnel values of the drag coefficient k_D should be corrected for tunnel-wall constraint. Further experiments with plates of breadths 2, 4, 8 in. show that these corrections lead to a much closer agreement with Kármán's k_D; but the observed k_N do not require any correction. H. B.

246. Electrical and Magnetic Phenomena in Crystals. J. Beckenkamp. *ZS. f. Phys.* 45. 5–6. *pp.* 369–383, 1927.

A general discussion of atomic and crystal structure with considerations of astatic arrangements. **Errata** [*ibid. p.* 602, 1927]. W. H. Ge.

247. X-Ray Study of Carbon Steels. N. Seljakow, G. Kurdjumow and N. Goodtzow. *ZS. f. Phys.* 45. 5–6. *pp.* 384–408, 1927.

An X-ray and micrographic study by photographic methods of hardened carbon steels. A centred tetragonal structure differing slightly from that of α-iron is deduced. The axial ratio increases (i) with increase of carbon content and constant hardening conditions or (ii) with increase in the temperature of hardening and constant carbon content. The hardening process can be regarded as the persistence of a transition between the γ- and α-structure. W. H. Ge.

248. X-Ray Study of Ultramarines. Part II. F. M. Jaeger and F. A. van Melle. *K. Akad. Amsterdam, Proc.* **30. 4.** *pp.* **479–498, 1927.**

A fully reported account of the continuation of previous work [see Abstract 2451 (1927)]. The primary material ultramarine-blue—Guimet No. 7553 ($Na_6Al_4Si_6O_{23}S_2$?) and the related Ag-, AgNa-, Se- and AgSe-ultramarine, were studied by means of powder photographs, and the whole of the work appears to be reported in chronological order. W. H. Ge.

249. X-Ray Study of Polymerisation Products of Formaldehyde. J. Hengstenberg. *Ann. d. Physik*, 84. 2. *pp*. 245–278, *Oct*. 4, 1927.

An X-ray study by means of powder photographs, all of which are similar, of some polymerisation products of formaldehyde. Particulars are given of the habit and size of the crystals and possible unit cells are suggested. The relation of the work to that on cellulose is discussed.

W. H. GE.

250. Grating Constants of the CaS- and SrS-Samarium Mixed Phosphors. E. Rumpf. *Ann. d. Physik*, 84. 2. *pp*. 313–322, *Oct*. 4, 1927.

The grating constants of mixed phosphors of CaS and SrS were found by the Debye-Scherrer arrangement. There is a continuous change from the pure CaS to the pure SrS value which runs parallel to the change in the phosphorescence bands. For large Sr concentrations, lines of high order are broadened and not sharp, indicating a variability in the grating constant. This is explained by the relative deformability of the Ca and Sr ions. J. E.

251. Berek's Method for Determining Crystal Optics. W. Nieuwenkamp. *K. Akad. Amsterdam, Proc*. 30. 5. *pp*. 534–542, 1927.

A graphical method for simplifying the calculations required when Berek's method of determining the optical properties of a crystal is used.

W. H. GE.

252. Crystalline Structure of Trichloromercurate of Cæsium. G. Natta. *Accad. Lincei, Atti*, 5. *pp*. 1003–1008, *June* 19, 1927.

Trichloromercurate of cæsium, $CsHgCl_3$, obtained by crystallisation of a solution containing an excess of CsCl, belongs to the monometric system. It has an elementary cubical cell of side 5·44 Å. The position of the ions in the cell is defined by Hg($\frac{1}{2}$, $\frac{1}{2}$, $\frac{1}{2}$), Cs(0, 0, 0), Cl($\frac{1}{2}$, $\frac{1}{2}$, 0), (0, $\frac{1}{2}$, $\frac{1}{2}$), ($\frac{1}{2}$, 0, $\frac{1}{2}$). The calculated density is 4·53. A. D.

253. Crystalline Structure of Hydrate of Calcium. A. Rejna. *Accad. Lincei, Atti*, 5. *pp*. 1008–1010, *June* 19, 1927.

The values $a = 3{\cdot}52$, $c = 4{\cdot}93$ given by Levi are confirmed, and for u it is assumed that $u \sim \frac{1}{4}$; the coordinates of Ca and O being Ca (0, 0, 0) and O($\frac{1}{3}$, $\frac{2}{3}$, u), ($\frac{2}{3}$, $\frac{1}{3}$, $\bar{u}$). A. D.

254. Crystalline Structure of Thallium. K. Becker. *ZS. f. Phys*. 45. 5–6. *p*. 450, 1927.

Levi has recently published a reply to the author's paper in which it was shown that the crystals are not hexagonal with closest packing [see Abstract 2215 (1927)]. No new evidence has, however, been brought forward by Levi which invalidates the author's conclusion. H. N. A.

255. The Crystal Structures of Mercuric and Mercurous Iodides. M. L. Huggins and P. L. Magill. *Am. Chem. Soc., J*. 49. *pp*. 2357–2367, *Oct*., 1927.

A determination of the crystal structure of tetragonal HgI_2 using (*a*) spectral data alone, (*b*) from Laue photographs, together with the spectra from (100), (110) and (001) planes. The dimensions of the molecular unit are given. The valence electrons are probably in pairs at tetrahedron corners around both Hg and I atoms, each Hg being bonded to four I atoms and each I to two Hg atoms. The structure is described as consisting of " layer molecules " with an interatomic distance (Hg–I) within each layer of 2·77 Å. The shortest distance (I–I) between atoms in different layers is 4·10 Å. Similar dimensions are given for the tetragonal prism unit of Hg_2I_2. In this case the structure is built up of IHg–HgI molecules within which the Hg–Hg distance is 2·72 Å. and the distance Hg–I 2·75 Å. These results are in good agreement with those obtained by X-ray analysis due to other workers. S. G. B.

256. The Crystal Structure of Some of the Alums. J. M. Cork.

Phil. Mag. 4. *pp.* 688–698, *Oct.*, 1927.

Space group for all the alums investigated T_h^6, agreeing with the result of Wyckoff, four molecules to the unit cubic cell. The sheet electron densities for planes normal to the (111) set for the different alums have been worked out by means of Fourier analysis, and are represented in a diagram, the similarity of the curves indicates the effect of changing either the monovalent or trivalent metal atom, and conclusions are drawn as to the positions of the sulphur atoms and the remaining atoms. Two alternative arrangements are arrived at, and are illustrated by diagrams showing the positions of the monovalent metal, oxygen, trivalent metal and sulphur atoms; the hydrogen atoms are not shown. A table of figures is given for the positions of the atoms in the second more probable arrangement. H. N. A.

257. Experiments on the Recrystallisation of Silver and Copper. H. Widmann.

ZS. f. Phys. 45. 3–4. *pp.* 200–224, 1927.

A description of an X-ray study of the recrystallisation processes on subsequent heat treatment of rolled silver and copper foils with particular attention to the reorientation of the crystal units. The influence of grain size on the physical properties of the metals is discussed, as well as the profound influence of relatively small amounts of impurity on the lower limit of temperature at which the recrystallisation commenced. W. V. M.

258. The Mutual Action of Two Hydrogen Atoms. S. C. Wang.

Phys. Zeits. 28. *pp.* 663–666, *Oct.* 1, 1927.

Deals with the perturbation problem for two hydrogen atoms at a distance from one another, using Schrödinger's equation and Epstein's mathematical method. The final result obtained is that the mutual potential energy of two H atoms in the normal state, and separated by the distance R, is $-\ 243\, e^2a^5/28R^6$, where a is the radius of the first Bohr circle in the H atom. It appears that this energy, calculated from the quantum theory, can be explained in terms of the classical theory as the polarisation effect which two atoms with electrical moments $\mu = 0\cdot 982ea$ produce on one another. **Errata** (*ibid.* p. 868, Dec. 1, 1927). H. N. A.

259. Quantum Theory of the Ionised Hydrogen Molecule. A. Unsöld.

ZS. f. Phys. 43. 8. *pp.* 563–574, 1927.

The energy of the hydrogen molecular ion is calculated. Mathematical. A. C. M.

260. Transition Probabilities in the Lithium Atom. B. Trumpy. *ZS. f. Phys.* 44. 8. *pp.* 575–584, 1927.

The absorption of lithium vapour was obtained by passing light through an iron tube heated to 1000° C., the tube being filled with argon. The transition probability for a given " switch " was got by determining the absorption curve for the line, and then determining the total area of the curve with a planimeter. For higher quantum numbers good agreement was obtained with the values reckoned by Pauli, Jr., by the Schrödinger method for the Lyman series. For small quantum numbers there were slight deviations. A. C. M.

261. Atomic Weight of Antimony. K. R. Krishnaswami. *Chem. Soc., J. pp.* 2534–2539, *Oct.*, 1927.

The recent determinations made by Willard and McAlpine, by Weatheril and by Hönigschmid, all using antimony obtained from Kahlbaum, all gave atomic weights of the order 121·75. Muzaffar, working with antimony from Brazil and other sources, found values ranging from 121·44 up to 122·374. The author takes stibnite and also cervantite from four sources in India and Burma, and further antimony from Kahlbaum, using the bromide method of Willard and McAlpine; Muzaffar's bromate method was not found satisfactory. All the determinations gave atomic weights lying between 121·744 and 121·754; there was no indication of any variation in the atomic weight. H. B.

262. The Critical Potentials of Nitrogen and the Nature of Active Nitrogen. A. S. Levesley. *Faraday Soc., Trans.* 23. *pp.* 552–560, *Sept.*, 1927.

The existing experimental evidence with regard to the resonance potential of nitrogen obtained by means of electronic bombardment is somewhat conflicting, and does not agree very well with Birge's scheme of energy levels; the author has employed the method of Hertz which has not previously been used for nitrogen. Curves were obtained which give a measure of the proportion of the current carried by very slow moving electrons, the curves show well-marked maxima and minima. The mean position of the first minimum was at 6·30 volts and of the second at 12·6 volts, double the voltage of the first. The author concludes that the collisions between the electrons and the N_2 molecules becomes inelastic when the former attain 6·3 volts energy; starting from this point they appear to be inelastic over a range of about three volts. These inelastic collisions may be associated with the excitation of a band system of nitrogen in the ultra-violet, having the stable state of the molecule for its final state. H. N. A.

263. The Specific Heat of Carbon Dioxide and the Form of the CO_2 Molecule. W. H. McCrea. *Cambridge Phil. Soc., Proc.* 23. *pp.* 890–900, *Oct.*, 1927.

A discussion of the Dennison and Eucken forms for the CO_2 molecule in the light of the specific heat curves based on these models. Neither the triangular nor the straight line model is satisfactory over the whole temperature range, and the discrepancies are treated theoretically. For low temperatures it is hypothesised that whenever the vibration v_3 is not excited the molecule is linear, but when excited the molecule has the triangular form. This hypothesis is utilised to explain the outstanding difficulties in interpreting the fine structure of the bands and also to obtain agreement for low temperatures. For high temperatures the above assumption makes no difference, and it is shown that the error in one of the curves is of the order anticipated by a centrifugal stretching of the molecule. S. G. B.

264. The Atomic Volumes of Zirconium and Hafnium. A. E. van Arkel. *Zeits. phys. Chem.* 130. *pp.* 100–104, *Oct.*, 1927.

The author, after giving a *résumé* of previous work in this field, describes the experimental investigation which is mainly concerned with obtaining suitable materials for the purpose in hand. The atomic volumes of zirconium and hafnium are found to be 13·97 ± 0·02 and 13·66 ± 0·06 respectively, and the atomic densities, 6·53 ± 0·01 and 13·08 ± 0·05. H. H. Ho.

265. Shared Electrons and Valency. W. A. Noyes. *Zeits. phys. Chem.* 130. *pp.* 323–333, *Oct.*, 1927. *In English.*

As ammonium compounds like trimethylethoxyammonium hydroxide and ammonium bromide are almost completely ionised in diluted solutions, the ionisation of quaternary ammonium compounds seems to depend primarily on the four pairs of electrons shared by the nitrogen atom, and not on the nature of the atoms with which electrons are shared. It would follow that: (1) in compounds containing only covalencies the sum of the pairs of shared electrons plus the unshared electrons is equal to the number of valency electrons for each atom; (2) in each positive (negative) ion there is some characteristic atom for which this sum is smaller (greater), by the charge of the ion, than the number of valency electrons of the free atom; (3) many compounds, which seem exceptions to this rule, are easily explained by assuming semi-polar unions. Generalised it may be stated that, in balancing the positive charge of the kernel (in the sense of G. N. Lewis), a pair of shared electrons is equivalent to a single unshared electron. This generalisation is supported by (or consistent with) a series of recent researches on the formation of ions, radioactive charges, thermal dissociation, the Hückel-Grimm law of double unions, potential polarities, principal and contra-valencies, atoms without full octets and condensation of carbon compounds. The principal valencies towards hydrogen are limited to the number of hydrogen atoms which can be taken up in accordance with (1). In isolated hydrogen atoms, which are magnetic, the electrons rotate about the nucleus of the atom; in hydrogen molecules (non-magnetic) two electrons rotate in opposite directions in parallel orbits with the two nuclei located in a plane lying between the planes of these orbits. The electrons of a covalency (German homœopolar) so rotate in opposite directions about the kernels of the two atoms which are held together, while the electrons of a polar (German heteropolar) valency rotate about the kernel of only one of the atoms. According to Hückel-Grimm any element with a kernel having a positive charge of 4, 5, 6, 7 may take up 4, 3, 2, 1 hydrogen atoms (or univalent groups resembling elements) 4, 3, 2, 1 places to the right in the periodic system. Semipolar or mixed double bonds are ascribed by Phillips and Sugden to optically active sulphinates. Potential polarities should be distinguished from polar and non-polar unions, which designate atoms actually in the ionic or semi-ionic condition. H. B.

266. Quantum Faults and Completed (Deck) Operations. N. H. Kolkmeijer. *Zeits. phys. Chem.* 130. *pp.* 95–99, *Oct.*, 1927.

In a previous paper [see Abstract 28 (1922)] the author has applied symmetry principles to space-time symmetry [see also Abstract 2475 (1927)]. He now describes completed (Deck) operations for space-time homometry and then, for example, considers the case of an electron rotating round a nucleus of protons and giving rise to a spectrum unlike that of hydrogen. The conclusion is drawn that a quantum fault is equivalent to a space-time-homometric deck operation, and various consequences are then deduced. The paper is entirely mathematical.
H. H. Ho.

267. The Fundamental Equation of Quantum Chemistry. T. de Donder. *Comptes Rendus*, 185. *pp.* 698–700, *Oct.* 10, 1927.

In this entirely mathematical note it is shown how the quantification equation of molecular systems, comprising any number of electrified mass points producing a gravitational field, may be deduced from the Einstein equation. H. H. Ho.

268. Interpretation of the Masses of the Electron and Proton in a Universe of Five Dimensions. A. Schidlof. *Comptes Rendus*, 185. *pp.* 889–891, *Oct.* 31. 1927.

De Broglie [see Abstract 2827 (1927)] has given a very simple geometrical representation for the electric charge of a material point in the five-dimensional universe of Kaluza based upon Klein's [see Abstract 2541 (1926)] theoretical considerations. The present author now investigates the form of the above expression when the limitations assumed by Klein and de Broglie are removed. H. H. Ho.

269. The Damping Problem in Wave Mechanics. L. Landau. *ZS. f. Phys.* 45. 5–6. *pp.* 430–441, 1927.

Heisenberg [see Abstract 38 (1928) has shown that in wave mechanics a system cannot be uniquely defined, and a formula is now derived for the treatment of the damping problem. By its aid several relevant problems are investigated, whilst it is also shown how coherence phenomena may be explained. An expression for spontaneous emission has been obtained and the problem of the intensity of the spectral lines solved by its means. H. H. Ho.

270. The Elementary Action-Quantum as a Consequence of the Theory of Relativity. A. Haas. *Phys. Zeits.* 21. *pp.* 707–709, *Nov.* 1, 1927.

The conception of an elementary action-quantum is deduced from the special theory of relativity by identifying the mechanical velocity with the group velocity as considered in wave-mechanics. [See Abstract 44 (1928).] J. S. G. T.

271. Time Measurement in an Isotropic Space Frame. J. L. Synge. *Roy. Irish Acad., Proc.* 37. *pp.* 110–115, *June*, 1927.

The transitivity of simultaneity, *viz.*, that if an event A is simultaneous with an event B, and B with C, then A is simultaneous with C, is deduced from the postulate of the complete isotropy of the space frame with regard to light propagation. J. S. G. T.

272. Kolkmeijer's Space-Time Groups. A. C. Lunn and J. K. Senior. *Phys. Zeits.* 21. *pp.* 711–712, *Nov.* 1, 1927.

Errors occurring in the symbolism and tables given in a previous paper [see Abstract 2475 (1927)] are corrected. J. S. G. T.

273. The Principle of Motion in the General Theory of Relativity. K. Lanczos. *Phys. Zeits.* 21. *pp.* 723–726, *Nov.* 1, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

The author seeks to resolve the difficulty of the dualism of the electromagnetic-material field, in which the field produces an effect upon matter at the same time as matter influences the field, by assuming a non-linear character for the field equations, the g_{ik} being expanded in power series. [See also Abstract 3060 (1927).] J. S. G. T.

274. The Problem of *n* Bodies in the Theory of Relativity. T. de Donder. *Comptes Rendus*, 185. *pp.* 933–934, *Nov.* 7, 1927.

The partial differential equations referring to the gravitational field of n masses are deduced by a generalisation of Einstein's theory. J. S. G. T.

275. Deduction of the Field Equations of the General Theory of Relativity. H. Mandel. *ZS. f. Phys.* 45. 3–4. *pp.* 285–306, 1927.

In a previous paper [see Abstract 64 (1927)] the question of the dependence of γ_{ik} upon the fifth coordinate essential for the interpretation of the electromagnetic properties of matter was left open. In the present paper the theory is developed on the assumption that R_5 is characterised by marked cylindricity. Applications of the theory to the atomicity of the electromagnetic field are briefly discussed. J. S. G. T.

276. The Trouton-Noble Ether Drift Experiment. C. T. Chase. *Phys. Rev.* 30. *pp.* 516–519, *Oct.*, 1927.

In view of the recent theoretical investigations by Epstein, which show that the sensitivity of this experiment is less than had been supposed and thus render inconclusive the previous performance of the experiment by the author [see Abstract 58 (1927)], the experiment has been repeated once more with still greater sensitivity. The present apparatus should detect a motion in the ether of as low as 3 km./sec. and no such motion is found. AUTHOR.

METEOROLOGY AND GEOPHYSICS.

277. Turbulence. G. I. Taylor. *Roy. Meteorolog. Soc.*, *J.* 53. *pp.* 201–212, *July*, 1927.

The lecture deals essentially with a number of the outstanding features of turbulent motion in a non-mathematical way. Analogies are drawn between the motion of gases and liquids and the effects of turbulence in each in modifying the transfer of heat or momentum. The results of turbulence in regulating the transfer of heat and water vapour were illustrated by results obtained off the Newfoundland Banks. An examination of Stanton's figures showed that the equation $p + \rho u^2/2 =$ const. holds if u is the average variation in wind velocity from the mean. These results obtained confirmation by an examination of the anemograms from Pyestock Tower. These showed that the ratio of the variation of the wind velocity from the mean to the mean wind was directly proportional to sin $(\theta/2)$, where θ is the angular variation of wind velocity. Further, the horizontal component of the eddy motion across the wind is equal statistically to the component along the direction of the mean wind. Thus, when density stratification acts so as to reduce turbulence, the lateral motion is reduced in the same ratio as the longitudinal motion. Further tests showed that the average values of the component of eddy velocity in a vertical direction is equal to the average horizontal component in a direction at right angles to the mean wind. R. S. R.

278. Influence of the Atmospheric Constituents upon Climate. L. B. Aldrich. *Nat. Research Council, Bull.* 61. *pp.* 19–24, *July*, 1927.

In considering possible changes in the composition of the atmosphere, which might affect temperature and so produce changes of climate, N_2 and O_2 can be ruled out, but water vapour, clouds, dust, O_3 and CO_2 are effective. Water vapour transmits solar radiation through the range $0\cdot3\,\mu$–$3\cdot0\,\mu$, but even a small amount is sufficient to screen all terrestrial radiations which lie between $4\,\mu$ and $50\,\mu$. Any reasonable variations of water-vapour content can have little effect on climate, but a change in total cloudiness, with other factors unchanged, can have an effect. Dust acts in an inverse way for solar and terrestrial radiation to water vapour. An increase in fine dust, such as by volcanic eruptions, could effectively lower the temperature, but decreased dust content could not produce the temperatures of warm geographical epochs. Variations in CO_2 through a wide range would cause little change in temperature. A large increase in the amount of O_3 in the upper air would probably effectively lower surface temperatures. As yet, however, exact data are unavailable regarding the formation of atmospheric ozone and regarding its ability to transmit radiation. R. S. R.

279. Distribution of the Mixing Ratio of Aqueous Vapour in Atmospheric Air near the Earth's Surface. T. Minami and Y. Hukumoto. *Faculty of Sci. Tokyo, J.* 1. *pp.* 339–345, *May* 30, 1927. *In English.*

Specific humidity or approximately the mixing ratio may serve to identify an air current at some places and in its original upper stream, although evaporation, condensation or precipitation may cause difficulties by altering the water content. The mixing ratio is defined as the amount in grammes of aqueous vapour actually mixed with 1 kilogramme of dry air, and is given by $0\cdot623\,(p_2/p) \times 100$, where p_2 and p are respectively the vapour tension and the barometric pressure. For a series of stations in Japan charts illustrate the mixing ratio and isobaric distributions at 6h., 14h. and 22h. for February 14th, 15th and 16th, 1907, lines of equal mixing ratio being also drawn. Further charts illustrate the 8h. and 24h. changes in mixing ratio. There are indications of (1) a diurnal variation of the mixing ratio and (2) a variation due to atmospheric perturbations. Further, the mixing ratio increases when precipitation sets in and *vice versa*. Further tests are to be made. R. S. R.

280. Periodicity and its Existence in European Weather. G. T. Walker. *Roy. Meteorolog. Soc., Mem.* 1. 9. *pp.* 119–126, *Aug.*, 1927.

To save unnecessary calculations, the author examines the amplitudes of a number, p, of the periods that can be derived by analysing a series of numbers to find how many of these are independent; the biggest amplitude also is compared with the probable biggest produced by purely random figures. This theory is then applied to Brunt's results on periodicity in European weather [see Abstract 1666 (1927)]. The author concludes that the periods in temperature of 12½ and 13 months, apart from the annual period, may be regarded as real, and there are others worthy of consideration. It is further shown that under ordinary conditions it is sufficient if, instead of the accurate figures to be analysed, group figures are used of which the interval is as large as a third of the standard deviation. R. S. R.

281. Mean Cloudiness over the Earth. C. E. P. Brooks. *Roy. Meteorolog. Soc., Mem.* 1. 10. *pp.* 127–138, *Sept.*, 1927.

The data available consisted of monthly averages of mean cloudiness at more than 1000 land stations distributed as evenly as possible over the earth, including a number of oceanic islands, data for 10° squares of latitude and longitude in the Atlantic and Indian Oceans, and the results of several expeditions in Arctic and Antarctic waters. The mean cloudiness for each 10° square was calculated and isonephs drawn. Some areas over the Pacific and South Atlantic were without data. In tables the monthly mean cloudiness is given for (1) land, (2) sea, and (3) land and sea for each 10° of latitude, and separately for each hemisphere as a whole and for the earth. The results are also shown diagrammatically. The variation of cloudiness with latitude is very similar to that found by S. Arrhenius from T. de Bort's chart of mean annual isonephs, but with considerable differences of detail. The results agree well with those of L. B. Aldrich. The regions of maximum cloudiness are given, and as a whole the sea is found to be more cloudy than the land. While the southern hemisphere is appreciably cloudier than the northern, the corresponding sea areas differ little in mean cloudiness. Finally, values are given to indicate the diurnal variation of cloudiness. R. S. R.

282. Variations of the Amount of Ozone contained in the Atmosphere. J. Cabannes and J. Dufay. *J. de Physique et le Radium*, 8. *pp.* 353–364, *Sept.*, 1927.

The authors have previously shown that the thickness of the layer of ozone can be determined from measurements of the transparency of the atmosphere in the visible spectrum [see Abstract 2229 (1927)]. In this paper they use the monthly means of transparency factors obtained by Abbot and Fowle at Mt. Wilson, 1908–1920, and at Calama, Chili, 1918–1920, and seek to trace the history of the ozone layer above these two stations between the given dates. At Mt. Wilson a seasonal variation exists similar to that observed at Oxford by Dobson and Harrison. From June to October, and perhaps even from May to November, the thickness of the ozone layer diminishes by nearly one-third. At Calama, a tropical station in the southern hemisphere, the seasonal variation is scarcely perceptible, and occurs in the reverse sense. There also exist slower variations of irregular periods whose amplitude can exceed one-third of the total thickness. The curve of yearly means of thickness of ozone differs notably from those which represent the annual values of the number of sunspots and the solar constant. There appears, however, to be a certain relation to the solar activity, with less ozone in the years of feeble activity preceding the minimum of 1913. R. S. R.

283. Evaporation from Lakes. N. W. Cummings and B. Richardson. *Phys. Rev.* 30. *pp.* 527–534, *Oct.*, 1927.

Evaporation can be determined by the aid of the first law of thermodynamics in such a way that wind velocity need not enter the calculation. Air temperature and humidity enter only as terms in a correction which can have a relatively small average value under typical conditions. The complete equation is $E = (H - S - C)/L(1 + R)$, where E is the evaporation, H the difference between the incoming and outgoing radiation, S the heat stored in a column of water having unit cross-section, C a correction for heat carried by flowing water and leakage of heat through the walls of the vessel, L the latent heat of water, and R is Bowen's ratio. A method of finding the difference between the incoming and outgoing radiation by means of observations on a well-insulated pan is described, and also a method of finding the ratio of the sensible to the latent heat transmitted through the air-water surface. Bowen's theoretical conclusions respecting this ratio were found to be consistent with observations. The above formula can be used in estimating the evaporation from an actual lake whenever the requisite data can be obtained. Although from a physical standpoint the quantity of sensible heat passing through the air-water surface is not strictly negligible, nevertheless in most meteorological and engineering applications the error caused by neglecting this quantity will be negligible in comparison with other errors that enter the main problem of which evaporation is a part. AUTHORS.

284. Improved Water-Flow Pyrheliometer. W. M. Shulgin. *Monthly Weather Rev.* 55. *pp.* 361–362, *Aug.*, 1927.

The apparatus has for its object an improvement of the construction and increased accuracy of the water-flow pyrheliometer devised by Abbot. Details are given of the theory of the method and of the apparatus. An error not greater than 0·1 % is obtained, depending on the sensitivity of the galvanometer. Further improvements are proposed. R. S. R.

ASTROPHYSICS.

285. The Chromospheric Spectrum as Observed with an Objective Prism at the Eclipse of January 24, 1925. G. F. Paddock. *Astrophys. J.* 66. *pp.* 1–12, *July*, 1927.

At the moment of central phase a photograph of the spectrum of the chromosphere was secured with an 8-in. 15° prism in front of the 12-in. lens of the 15-ft refractor of Ladd Observatory. The spectral arcs shown on the negative are identified with the principal chromospheric lines. From the measured angular extent of the arcs are computed the apparent heights of the radiating gases. The northern edge of the shadow passed three-quarters of a mile (1·2 km.) south of the observatory. The minimum width of crescent was $0''\cdot8$, corresponding to one and a half seconds of time before totality on the central line. The difference between the centres of the sun and moon was derived from the plate, giving a correction to the almanac value of the moon's declination of $\Delta\delta = +0''\cdot85$. The hydrogen arcs observed on the photograph show the usual definite decrease in length and intensity from H_α towards the violet. If at the time of such an observation provision were made for the photometric measurement of the gradients of line intensities and the ratios of intensity in the series lines, the data derived would aid in the study of the physical condition of the chromosphere and its radiation. Observation at the edge of the path of the shadow has the advantage of longer time for exposures and of securing the full lengths of spectral arcs.

AUTHOR.

286. The Structure of the Fraunhofer Lines and the Dynamics of the Solar Chromosphere. A. Unsöld. *ZS. f. Phys.* **44.** 11–12. *pp.* 793–809, 1927.

It is shown that the structure of the resonance lines in the solar spectrum can be explained on the assumption that "true" absorption is not an important factor in the production of these lines, but that when the photoelectron of an atom or ion is raised to an excited state by a light quantum the absorbed energy is in almost all cases radiated in all directions with the same frequency. The theory is worked out in relation to the H and K lines of $Ca^+(4^2S - 4^2P_{1,2})$, making use of the theory of "diffusion" of the radiation owing to this scattering developed by Schuster and by Schwarzschild. If the height of the calcium chromosphere is taken as 14,000 km., and the pressure as 5×10^{-8} atmospheres, the calculated intensities at different points in the breadth of the two lines agree fairly well with those observed. The correctness of the above pressure is confirmed by the results of a theory which explains the existence of the layer by considering the effect of the pressure due to light from the photosphere on the Ca^+ ions and the action of gravitation. The former force is estimated as 1·64 times the latter, and the outward currents observed by St. John in the chromosphere are probably due to this fact. It is suggested that in the upper layers the Ca^+ is ionised to Ca^{++}. The light pressure on this is much smaller than on Ca^+, and it falls towards the photosphere.

H. N. A.

287. Structure of the Solar Chromosphere. L. d'Azambuja. *Comptes Rendus*, 185. *pp.* 637–639, *Oct.* 3, 1927.

An extension of the author's previous work on the structure of faculæ [see Abstract 928 (1927)]. He employs (1) seven lines with pronounced wings belonging to various neutral elements, (2) line 4078(8) of ionised strontium, and (3) the iron line λ4202(8), the two latter being almost devoid of wings, and describes the appearance as the slit is placed (*a*) exactly at the middle of a line, (*b*) at two narrow regions situated near the centre but on its borders, and (*c*) outside these two regions. A. S. D. M.

288. Multiplets of the Nickel and Cobalt Arc Spectra in the Chromospheric Spectrum. C. R. Davidson and F. J. M. Stratton. *Roy. Astron. Soc., M.N.* 87. *pp.* 739–747, *Oct.*, 1927. *Supplementary Number.*

In a Report on the Total Solar Eclipse of 1926, Jan. 14th [see Abstract 2231 (1927)], lists were given of unclassified lines of nickel and cobalt which had been photographed in the chromospheric spectrum. These have now been compared with an analysis of the nickel arc spectrum into multiplets by Bechert and Sommer, and a study of the cobalt arc spectrum by Catalan and Bechert. The comparison shows that, in the range considered, 3100 Å. to 4000 Å., practically every line in the arc spectrum of nickel arising from two terms with the serial number one is present in the chromosphere, but only one line arising from the higher energy levels associated with the serial number two is present. The unclassified lines of cobalt can also now be classified in multiplets, and fresh identifications of cobalt lines in the chromospheric spectrum have been made. Catalogues of the lines are given, grouped into multiplets, with descriptive remarks and notes. A short list is added of multiplets of Co which might be expected, but do not appear. M. A. E.

289. Revision of Rowland's "Preliminary Table of Solar Spectrum Wave-Lengths." C. E. St. John. *Nat. Acad. Sci., Proc.* 13. *pp.* 678–683, *Sept.*, 1927.

Rowland's "Preliminary Table of Solar Spectrum Wave-Lengths," containing 20,000 lines, was published in 1893, and has been the world's standard until now. It was remarkably accurate for the time, but there were many and irregularly distributed errors, and no allowance was made for the effect of the rotation and the orbital movement of the earth. In 1893, by the use of the Michelson interferometer, the absolute wave-length of the red cadmium line was determined with a hitherto undreamed-of precision, and when it had been re-determined in 1907 its value of 6438·4696 Å. was adopted as the primary standard, and is believed to be accurate to 1 part in 10 million. With the interferometer, other spectral lines can be directly referred to the primary standard, thus eliminating the cumulative errors of the less direct methods hitherto employed; and under the auspices of the International Union for Cooperation in Solar Research a list of secondary standards, and later of tertiary and auxiliary standards, was established. In the investigation carried through at Mt. Wilson, the values rest upon two independent series of measurements, and are in excellent agreement and have been corrected for the daily and yearly movements of the earth. These results are now nearly ready for publication. The identifications of elements given in Rowland's table have been revised, and many new identifications are added. Lines due to ionised atoms are indicated by the sign +, and the principal constituent of a multiple identification is underlined. Following Rowland's column of disc intensities is a new column giving the intensities in sunspot spectra, and other new columns give temperature classification from furnace spectra, pressure classification, and the excitation potential of lines identified in series and multiplets. M. A. E.

290. Report of the Expeditions from the Royal Observatory, Greenwich, to Observe the Total Solar Eclipse of 1927, June 29. *Roy. Astron. Soc., M.N.* 87. *pp.* 657–696, *Oct.*, 1927. *Supplementary Number.*

291. Classification of Spiral Nebulæ. E. Hubble. *Observatory,* 50. *pp.* 276–281, *Sept.*, 1927.

A reply to criticism by J. H. Reynolds. The author gives three criteria for spiral classification: (1) The relative size of the unresolved nuclear region; (2) the openness of the spiral; (3) the degree of condensation in the arms, and also obtains quantitative results from a statistical comparison of spirals with Holetschek's nebulæ. Reynolds accepts criterion (3) and appears to accept criterion (1), but objects that the development of the spiral form should be taken to a certain degree as an indication of age, which, to the author, "appears to be an intuitive judgment, and as such has little bearing on an empirical investigation." He also questions the validity of combining Holetschek's visual magnitudes measured with a 6-in. refractor with angular diameters measured on photographs with large reflectors, but the author argues that here the essential features are a homogeneous list of diameters and a homogeneous list of magnitudes. Other criteria are mentioned by Reynolds, which the author considers important if they could be made quantitative. The author points out that in actual practice the system works well; out of more than a thousand spirals examined, not more than a dozen failed to fit into the sequence. [See Abstract 1683 (1927).] A. S. D. M.

292. Nebular Ionisation. B. P. Gerasimovič. *Am. Acad., Proc.* 62. *pp.* 155–171, *Aug.,* 1927. *Harvard Reprint* 38.

The electron temperature of a planetary nebula under the influence of the radiation of a very hot star is calculated, assuming a steady state and the presence of atoms with one stationary state only. The temperature depends only on the exciting star and the optical thickness of the nebular layer. An ionisation formula is deduced and certain cases worked out. Calculation of the absorption coefficient agrees well with Kramers' theory. A. Wh.

293. Intensity of Cosmic Radiation. B. P. Gerasimovič. *Am. Acad., Proc.* 62. *pp.* 173–185, *Aug.,* 1927. *Harvard Reprint* 39.

From Millikan's observations at Muir Lake, the flux of cosmic radiation in free space is estimated to be of the order of 10^{-5} erg per cm.^{2} per second. The relative importance of this and of stellar radiation in maintaining the ionisation in diffuse nebular matter is discussed, and it appears that the penetrating radiation is of secondary importance. In super-giant stars of Class M, where there are large proportions of hydrogen and low densities, there seems a possibility that the anomalies noted by Payne and Rosseland in the behaviour of the enhanced lines may be explainable by the presence of local fields of penetrating radiation of great intensity.

A. Wh.

294. Distribution of Velocities of Stars of Spectral Type K. M. Kaburaki. *Faculty of Sci. Tokyo, J.* 1. *pp.* 285–300, *Dec.,* 1926. *In English.*

The absolute motions of stars in space are here investigated in some detail, on the basis of 315 stars of type K, whose proper motions, radial velocities, and spectroscopic parallaxes have already been determined by various observers. Grouping these stars according to absolute magnitude, it is clear that those between $-0\cdot5$ and $+2\cdot5$ and also those between $+5\cdot5$ and $+9\cdot0$ are very numerous, but others are very few: thus the distinction between giants and dwarfs becomes obvious. These giants have a smaller space-velocity than the dwarfs, the maximum frequency for giants being 18·9 km./sec. and for dwarfs 42·2 km./sec. The general relation between space-velocity and absolute magnitude is nearly linear, the velocity increasing at the rate of about 2·5 km./sec. for every decrease in brightness of one magnitude. The distribution of the space-velocities is clearly related to the galactic plane, for the centroids of both giant and dwarf groups lie nearly on the galactic plane and almost coincide with its adopted centre; but the size of the velocity-ellipsoid is much larger for the dwarf than for the giant stars. These conclusions are in satisfactory agreement with the results, reached in different ways, by Eddington, Douglas, and G. Prasad, Adams, Strömberg, and Joy. M. A. E.

295. Method of A. A. Michelson for Determining the Magnitude of Fixed Stars.

R. Bechmann. *Ann. d. Physik*, 84. 1. *pp.* 61–93, *Sept.* 10, 1927.

In this paper, which is of a mathematical nature, the method of Michelson for estimating the magnitude of the fixed star is transferred, according to a suggestion of H. Siedentopf, to the use of the microscope for determining the true value of ultra-microns. In the most important practical case of the two slits, the intensity ratio of the self-luminous and the non-self-luminous are essentially different from one another. The intensity distribution in the image possesses in the case of the self-luminous no zero point, while with the non-self-luminous it exists.

A. E. G.

296. The Nebulous Envelope Around Nova Aquilæ No. 3.

E. Hubble and J. C. Duncan. *Mt. Wilson Observat. Contrib. No.* 335. *Astrophys. J.* 66. *pp.* 59–63, *July*, 1927.

Photographs made with the 100-in. reflector at Mt. Wilson shows a nebulous disc around the nova, which expanded perceptibly during the interval of eleven months covered by the observations. Measures at four epochs give a mean diameter of $16''\cdot 4$ corresponding to the mean epoch, September 21, 1926. This indicates an angular increase in the radius of the expanding disc or shell of nebulosity of $1''\cdot 0$ per year, which is consistent with the earlier micrometric measures of the visual envelope. A comparison with the linear rate of expansion, 1700 km./sec. as derived from early spectrograms, leads to a distance of 360 parsecs ; $\pi = 0''\cdot 0028$. Slitless spectrograms show a strong image of the disc at λ4686, slightly weaker images at Hβ, Hγ and Hδ, and traces at N_1 and λ4363.

AUTHORS.

297. Three Long-Period Spectroscopic Binary Stars.

R. K. Young. *Dominion Astrophys. Obs. Victoria, Publ.* 4. 2. *pp.* 27–38, 1927.

The orbits of three late-type stars have been determined from one-prism spectrograms. (1) 4 Ursæ Minoris.—Thirty-eight plates taken during the years 1909 to 1924 have been made the basis for a least-squares solution. The period is 575 days. The range is small and the elements e and w are not well determined. (2) B.D. 66°878.—This is an M7-type star. Its binary character is well established, the period of variation being 750 days. The orbit rests upon a least-squares solution from 31 plates. (3) β Scuti.—Thirty plates have been made the basis for a least-squares solution. The period is 834 days, the range is fairly large, and the elements are well determined.

AUTHOR.

298. Selective Radiation Pressure and the Structure of Stellar Atmospheres.

E. A. Milne. *Roy. Astron. Soc., M.N.* 87. *pp.* 697–708, *Oct.*, 1927.

Selective radiation pressure is shown to be effective only in the outer layers of a stellar atmosphere. The physical conditions for the transition from local thermodynamic equilibrium to monochromatic radiative equilibrium are not accurately known. If the pressure for this transition is high, the upper reversing layer and chromosphere will be thick and absorption lines will be very black.

A. Wh.

299. Equilibrium and the Distribution of Energy Production in a Star. E. A. Milne. *Roy. Astron. Soc., M.N.* 87. *pp.* 708–720, *Oct.*, 1927. *Supplementary Number.*

If k be the coefficient of opacity at a distance r from the centre and η the ratio of the average rate of production of energy per gramme inside the sphere of radius r to that for the whole star, Eddington's solution of the problem of stellar equilibrium involves the approximation $k\eta = \text{const.}$ It is impossible to deal with the equations if $k\eta$ be assumed to be proportional to some power of the temperature. Instead the ratio of radiation pressure to total pressure is assumed to be some function of the temperature, and the necessary variation of $k\eta$ is then investigated. By an appropriate choice of the class of function Emden's differential equation is obtained. The equilibrium remains polytropic with index $3 - s$, where s is an arbitrary parameter which represents the degree of concentration of energy liberation in the star. A. Wh.

300. Liquid Stars. J. H. Jeans. *Roy. Astron. Soc., M.N.* 87. *pp.* 720–739, *Oct.*, 1927. *Supplementary Number.*

In a previous paper [Abstract 2239 (1927)] the conditions in stellar interiors were considered, where the gas laws are so far from being obeyed that the stellar material approximates to a liquid. In this paper the discussion is amplified and continued and the stability and evolution of liquid stars considered. It is shown that as a star contracts successive rings of electrons will be ionised, and as each ionisation range is reached the deviations from the gas laws will pass through a minimum. A diagram on the lines of Russell's is constructed showing regions of stability due to congestions of different electron rings. The main sequence is represented by congestion of the K-ring. Light is also thrown on the conditions for the formation of a long period variable. When a nebula contracts into a star a steady state will be reached if the mass is below a critical value, but if it is above this a pulsation with a period of the order of hundreds of days will be set up. In the white dwarf stage a star is practically stagnant. It consists largely of stripped nuclei jammed tightly together at a temperature of the order of 1,000,000,000° C. The absence of bound electrons renders the further generation of energy at the expense of mass impossible, while the loss of mass as radiation is extremely slow. (See also a further paper in *Nature*, 121. *pp.* 173–175, *Feb.* 4, 1928.) A. Wh.

301. The Source of Stellar Energy. J. Q. Stewart. *Frank. Inst., J.* 204. *pp.* 437–467, *Oct.*, 1927.

The author explains briefly how the energy of the sun is measured, reviews successive theories as to its source, and shows that none is adequate except the annihilation of matter and liberation of energy deep in the interior of sun and stars. He summarises the work of Eddington and others on the constitution and life-history of stars, and concludes that, although as yet we know very little about the source of energy, this little can be, and is, applied to the elucidation of astrophysical problems, and that before long the student of terrestrial physics will have new data and principles upon which to work. It is shown what an immensely powerful force for the world's work would be available if it ever became possible to utilise on the earth the source of stellar energy. M. A. E.

302. Effect of Galaxy Rotation on Proper Motions in Right Ascension and Declination. J. Schilt. *Nat. Acad. Sci., Proc.* 13. *pp.* 642–646, *Sept.*, 1927.

The author plots Gyllenberg's mean proper motions in Right Ascension and Declination of AG stars of different spectral types: they do not conform to sine curves; the deviations are not due to systematic errors in the catalogue places, nor are parallactic motions less in the Milky Way than near its poles; they may be due to a rotation of the stellar system [see Abstract 2688 (1927)]. He finds a similar term, having the argument 2α, to Oort's observed term of $a \sin 2l + b \cdot \cos 2l$ in the radial velocities of distant objects, which assumes that the rotational velocity depends only on the distance from the centre of the star system. He develops this and obtains consistent values from the independent data of μ_α and μ_δ, making the rotation-hypothesis probable. For five classes of magnitude ($< 7\cdot 9$; $8\cdot 0$–$8\cdot 5$; $8\cdot 6$–$8\cdot 8$; $8\cdot 9$–$9\cdot 1$; $> 9\cdot 1$) the direction of the centre of rotation runs from 348° to 332°—the mean for all magnitudes being 340°—decreasing regularly for the fainter stars, and this is probably real and due to the rotational centre being slightly different for different types. Shapley has found the centre of the globular cluster system to be 325°, which is too divergent from 340° for accident. He investigates the influence of the assumed rotation on the stellar parallactic motions in a certain declination zone, giving a table. For stars north of $+ 30°$ and south of $- 30°$, the difference between the mean parallactic motions is of the order of $0''\cdot 02$, the same as that found by Perrine between the northern and southern B stars, thus accounting for the asymmetry in proper motions of stars in the northern and southern hemispheres. A. S. D. M.

303. Discussions of Proper Motions in the Equatorial Zone. J. Schilt and (Miss) Ida Barney. *Astron. J.* 37. *No.* 885. *pp.* 181–190, *Sept.* 6, 1927.

A comparison of Yale Photographic Catalogue (zone $+ 2°$ to $- 2°$) proper motions with the Nicolajew (4408 stars) and Albany AG (932 stars). For Nicolajew, the values of μ_δ plotted against the right ascensions give a straight line, indicating that Struve's precession constant is correct. A table of the μ_δ mean values, corrected for colour [see Abstract 2055 (1926)] for the spectral types shows a large positive value for faint A stars (perhaps indicating a northward moving group), for B stars $>$ 8th mag., and F stars $>$ 9th mag.; the solar apex is different from that of the A and K stars in declination, increasing from A and F to K and especially G. The median values of μ_δ are practically the same as the mean values of B, A and F stars; they are systematically larger for G stars (especially the bright G stars, which are almost exclusively giants), and less markedly so for K stars; for the G and K stars of mags. 8–9, and $\geqslant 9$, there is no decrease in dispersion with decreasing brightness. A table is given of the components X and Y, and the corrections $\Delta\mu_\alpha$ for different magnitudes, of which the remarkable feature is the reversal in the amount of parallactic motion of stars of mag. 7–8; the mean parallactic motion decreases with decreasing brightness for A and F stars, but G stars show a definite increase in parallactic motion in passing from mags. 7–8 to 8–9, and K stars show similarly but at a fainter mag.; dwarf G stars begin to appear between mags. 8–9; dwarf K stars at a fainter magnitude. The authors support Strömberg's finding " that for the giant stars the declination of the sun's apex shows a steady increase from + 27° to + 44°," and that the apex for dwarfs is lower on the average than for giants. The Albany zone stars confirm these results. A constant, − 0″·018, is applied to the Nicolajew μ_δ and − 0″·003, to the Albany; for Yale-Nicolajew there is no appreciable systematic term $\Delta\mu_\alpha$ depending on m; for Yale-Albany this is − 0″·03 per year for faint stars. [See also preceding Abstract.]

A. S. D. M.

304. Proper Motions of Globular Clusters Messier 13, 56, 2, and their Internal Motions. A. van Maanen. *K. Akad. Amsterdam, Proc.* 30. 6. *pp.* 681–684, 1927.

A discussion of results from two pairs of plates of M.56 and one pair of M.2 taken at intervals of 9, 11 and 11 years at the Cassegrain focus of the 60-in. reflector, and one pair of plates each of M.13 and M.2 at intervals of 14 and 15 years at the Newtonian focus of the same instrument. All plates were measured with the monocular arrangement of the stereo-comparator. The relative motions, μ_α and μ_δ, are given for the three clusters and the mean motion of the comparison stars, and from these (by means of Table 26 of "Groningen Publications," No. 29) the absolute motions. Using Strömberg's value ($\bar{V}$ = 329 km./sec.) for the mean radial velocity of globulars, $\bar{\pi}$ = 0″·000061, which compares well with Shapley's 0″·000065 for the mean of the three parallaxes. For the Cassegrain focus the probable error of the motions is 0″·0030; for the Newtonian focus, 0″·0044. There is no pronounced motion parallel to their galactic planes in M.13 and M.2. The three clusters are, possibly, expanding, but the internal motions in the globular clusters are extremely small. The author concludes that the larger displacements found in spiral nebulæ are, therefore, not due either to difference of quality between old and new plates, to length of exposure, or to undue brightness of comparison stars.

A. S. D. M.

305. The Orbits of Two Spectroscopic Binaries. S. N. Hill. *Dominion Astrophys. Obs. Victoria, Publ.* 3. 18. *pp.* 349–363, 1927.

Kappa Draconis.—An orbit of the spectroscopic binary star Kappa Draconis, H.D. 109387, mag. 3·88, type B5p, was published by Baker from observations at the Detroit Observatory on the basis of a period of 8·986 days. Some observations at Victoria showed marked disagreement with this orbit, and consequently the star was re-observed here and a new orbit with a period of 0·89038 days, e = 0·186, K = 18·87 km., γ = − 11·43 km., was obtained from 38 plates. As the probable error per plate has the low value of ± 1·7 km. per sec. for this rather diffuse lined B star, there can be no reasonable doubt of the correctness of the new orbit.

H.D. 214240.—The first plate obtained showed double lines, and the orbit was determined from 32 plates. The Henry Draper Catalogue gives the spectral type as B3, visual magnitude 6·20. From an investigation of the spectrum the type of the primary is estimated as B2·5 and that of the secondary as B8. The lines in the secondary are faint and could only be measured with any degree of accuracy at the nodes, where the separation is about 200 km. The star has a high eccentricity, 0·253. The minimum masses are 6·01 and 3·87 times the sun. From probable estimates of density and calculated values of surface brightness it seems certain that this star is at least 1300 light-years distant.

AUTHOR.

LIGHT.

306. Light Absorption. S. L. Langedijk. *Z. wiss. Phot.* 25. *pp.* 29–32, *Oct.*, 1927.

Controverts Plotnikow [see Abstract 1696 (1927)]. A. D.

307. Absorption of Erythrosine Solutions. P. Vaillant. *J. de Physique et le Radium*, 8. pp. 391–396, *Oct.*, 1927.

The absorption of solutions of erythrosine in a number of solvents shows that Kundt's rule needs to be extended and made more precise. The displacement of absorption bands by change of solvent is the difference of two terms, the one proportional to change of refractive index and the other to variation of density. The displacement is constant throughout the width of the absorption band. F. S.

308. Relation between Refractive Index and Density. D. Burnett. *Cambridge Phil. Soc., Proc.* 23. *pp.* 907–911, *Oct.*, 1927.

Recently Macdonald [see Abstract 1481 (1927)] has given a theory for the dependence of the refractive index n of a medium on its density ρ which seems more in accord with the modern concept of atomic structure than some previous formulæ. His new formula is $\frac{n^2 - 1}{n\rho}$ = constant for a non-magnetic medium. The author examines a number of experimental results to see whether this new formula gives as satisfactory agreement as that of Lorenz and Lorentz. It is found that it does in most cases, and is occasionally the better. J. J. S.

309. Type of Photographic Telescope fixed Vertically, with Interchangeable Focal Ratios. G. W. Ritchey. *Comptes Rendus*, 185. *pp.* 758–761, *Oct.* 17, 1927.

The use of composite and cellular mirrors of pyrex or quartz has reduced very much the weight of large reflectors and a more constant temperature can be maintained. Details are given of a new pattern of telescope where the reflectors are of this type and the observer can with this carry out all kinds of astrophysical work with all the conveniences and perfection of a fixed laboratory maintained at a constant temperature. R. S. R.

310. The Tangent Lens Gauge Generalised. Alice Everett. *Phil. Mag.* 4. *pp.* 720–721, *Oct.*, 1927.

Describes a modification of Burch's tangent lens gauge, in which, instead of two plate-glass slips joined at an angle of nearly 180°, two spherical surfaces are employed. This can be used to measure either concave or convex surfaces, by determining the distance between the central dark spots of the Newton's ring systems formed at the two points of contact. H. N. A.

311. New Image Phenomena with an Astigmatic Lens. C. Lakemann and J. T. Groosmuller. *Zeits. phys. Chem.* 130. *pp.* 390–395, Oct., 1927.

The image of a lattice composed of vertical and horizontal wires as seen through an astigmatic lens is found to show particular lines when the meridian plane of the lens makes an angle of 45° with the wires. This phenomenon would appear to be identical with an earlier observation of Winkelmann [see Abstract 234 (1907)] which was ascribed to diffraction; it is now shown by a comprehensive experimental investigation that the lines are connected with the astigmatic construction of the lens.

H. H. Ho.

312. Behaviour of Different Metals as Semi-Transparent Layers in the Interferometer. P. Zeeman. *Zeits. Phys. Chem.* 130. *pp.* 237–240, *Oct.*, 1927. *In English.*

The author has used the Fizeau-Michelson method for the convection of light in moving water and also with slabs of quartz and glass in rapid motion and verified accurately the theory of Fresnel and Lorentz. The behaviour of a number of transparent metallic films in the interferometer has been examined and the results obtained with new and old silvered mirrors, semi-transparent mirrors of Pt, obtained by cathodic spluttering, a Cu mirror (cathodic spluttering), Au mirrors and a series of Au-Ag alloys. The effect of protecting the mirrors from the atmosphere by a celluloid film was also examined. R. S. R.

313. Diffraction of Light by Metallic Screens. C. V. Raman and K. S. Krishnan. *Roy. Soc., Proc.* 116. *pp.* 254–267, *Oct.* 1, 1927.

A mathematical discussion of the observations of Gouy on the intensity, colour and polarisation of the light diffracted through large angles by metallic screens and wedges with polished edges, the well-known expressions of Poincaré and Sommerfeld being modified to take into account the changes of phase and of amplitude which occur when light is reflected at the surface of a metal. F. S.

314. Diffraction of Light by Steel Knife Edges. F. Jentzsch. *Ann. d. Physik,* 84. 2. *pp.* 292–312, *Oct.* 4, 1927.

Describes observations on the rotation of the plane of polarisation of diffracted light, which confirm qualitatively the theory of Epstein; for a more complete investigation, accurate knowledge of the profile or radius of curvature of the knife edges employed is required. The microscope shows that all sharp knives and razor blades have minute notches and teeth in their edges, which make them unsuitable for accurate diffraction experiments. Various methods for measuring the radius of curvature of the edge of a knife blade are considered. All attempts to avoid the errors involved in using a knife edge by employing other methods have failed.

H. N. A.

315. The Dispersion of Methane. T. H. Havelock. *Phil. Mag.* 4. *pp.* 721–725, *Oct.*, 1927.

The regular progression of molecular refractivity in the gases Ne, FeH, OH_2, NH_3, CH_4 has led to the view that the four latter are built up of neon-like ions F^-, O^{2-}, N^{3-}, C^{4-}; when, however, the dispersion is considered it appears that the structure of methane must be different, since the constants C_0 and p_0 in the dispersion formula, which show a regular progression for the first four gases, cease to do so for methane. This is confirmed by recent investigations on the ionisation potentials of these gases, and attention is called to a close similarity between what the author calls the dispersion potentials and the ionisation potentials. The atomic binding in the methane molecule may be of the homopolar or electron-sharing type, but the possibility that the structure may be heteropolar, a C^{4+} ion with four H^- ions, is considered, and it is shown from refractivity considerations that this structure is quite probable. H. N. A.

316. Electric Birefringence of Benzil. R. de Mallemann. *Comptes Rendus*, 185. *pp.* 709–711, *Oct.* 10, 1927.

Benzil crystallises in the same system as quartz and in this state has an optical rotatory power of similar magnitude; X-ray analysis also indicates a similarity of crystal-structure. Its low melting-point, however, makes it a more suitable material for testing the relation between optical rotatory power and molecular anisotropy. Preliminary experiments with solutions in benzene, which has a very small Kerr constant, showed that that of benzil is negative (− 600 to − 700), and larger in value than that of other known negative compounds such as chloroform (− 100 about). It is proposed also to test the anisotropy of the compound by measuring the dielectric constants of the solutions. T. M. L.

317. The Change in the Number of Dispersion Centres of Sodium Vapour with the Temperature of the Saturated Vapour. M. Weingeroff. *ZS. f. Phys.* 45. 5–6. *pp.* 416–429, 1927.

Previous work in this field has only been done for the D-lines of sodium vapour by Minkowski [see Abstract 877 (1922)] and a new compensation method is now described by which any absorption line can be applied. By this method the D_1 and D_2 lines of sodium have been investigated, from which it is shown that the number of dispersion centres is proportional to the density of the saturated vapour. The heat of evaporation has also been evaluated, and, by its aid, the Nernst chemical constant has been calculated as 0·43, if the vapour pressure of Haber and Nisch, or 0·50, if that of Rodebush and de Vries be adopted; the theoretical value is 0·46. H. H. Ho.

318. Molecular Scattering of Light in Solid Bodies. Part II. Dependence of Scattered Light on Temperature. G. Landsberg. *ZS. f. Phys.* 45. 5–6. *pp.* 442–448, 1927.

The experimental arrangements were little changed from earlier tests [see Abstract 2875 (1927)] but an Osram point light was used. The light scattered by the quartz crystal at different temperatures was received on the photographic plate, and for each temperature a series of small spots obtained very close together corresponding to different light intensities. Taking Δ as the depth of blackening of the photographic plate, and i_0 and i the intensities of the light proceeding to the Pulfrich photometer through the unblackened and the blackened parts of the plate respectively, a linear relation was found of the form $\Delta = \log (i_0/i)$. This linear relation is in accordance with theory for molecular scattering. In the case taken 24 % of the scattering was due to want of homogeneity in the quartz crystal and the remaining 76 % is directly proportional to the absolute temperature. As another interpretation is possible it is desirable to obtain absolute values of the light intensity and compare with that calculated from the Einstein formula. R. S. R.

319. Scattering of Light by Liquids at High Temperatures. S. R. Rao. *Indian Journ. Phys.* 2. *pp.* 7–24, *Sept.*, 1927.

The variations of intensity and the depolarisation factor of the transversely scattered light are studied for isopentane, normal pentane, hexane, ethyl ether, methyl acetate and ethyl formate for different temperatures up to the critical point. The depolarisation factor diminishes at first very slowly with increasing temperature, then falls very rapidly and then less rapidly as the critical temperature is approached. The results at all temperatures agree very closely with Ramanathan's modified expression [see Abstract 2874 (1927)] based on molecular theory. The molecular anisotropy calculated for the six liquids at different temperatures; it appears to increase with temperature and to tend to attain the value for vapour: the explanation of this effect is discussed. A. D.

320. Scattering of Light by Aromatic Compounds. A. N. Banerjee. *Indian Journ. Phys.* 2. *pp.* 51–60, *Sept.*, 1927.

A description of a series of measurements of the depolarisation factor and the relative intensity with respect to benzene of some 28 aromatic compounds, in extension of the work of K. S. Krishnan [Abstract 79 (1926)]. The experimental results agreed fairly well with the theoretical formula for molecular scattering put forward by Ramanathan and better than with previous formulæ. Quinoline had the highest refractivity, boiling point, depolarisation and intensity. As to the values of intensity, in the case of nitro-benzene the experimental valve was higher than the calculated value was in excess. The observations are being extended to polarised light. S. G. B.

321. Determination and Discussion of Light-Scattering Data for 10 Gases and 63 Vapours of Organic Compounds. Part I. R. Rao. *Indian Journ. Phys.* 2. *pp.* 61–96, *Sept.*, 1927.

An attempt to elucidate the discrepancies in the study of depolarisation values by various observers and the extension of the method to the depolarisation values of 10 gases and 63 vapours. The method of Cabannes, wherein two images of the scattered light as seen through the double image prism are viewed in a common background is confirmed as being reliable. The depolarisation values are found to be independent of the convergence of the incident pencil of light, and a theoretical explanation is deduced. The smaller anisotropy of the liquid state of a molecule is compared with the larger value of that of the vapour state and explained. The fatty acids, however, show greater anisotropy in the liquid state, and it is supposed to be due to the longest geometrical axis of the molecule differing from the axis of greatest refractivity. The anisotropy of the carbon atom is discussed. S. G. B.

322. Scattering of Light in Amorphous Solids. C. V. Raman. *J.O.S.A. and R.S.I.* 15. *pp.* 185–189, *Oct.*, 1927.

In dust-free liquids there is a transverse scattering of light (mainly unpolarised) due to local fluctuations of density and to the random orientations of the molecules which cause the fluid to be optically inhomogeneous. In mixtures there is in addition a transverse scattering (fully polarised) due to local variations in composition and consequent variations in the refractive index. These persist when the mixture is congealed into an amorphous solid. Optical glasses show this scattering, in a way which shows this to depend upon the refractive index and on the chemical constitution, not upon accidental inclusions or incipient crystallisations. A. D.

323. Scattering of Light in Colloid Solutions. C. V. Raman. *Indian Journ. Phys.* 2. *pp.* 1–6, *Sept.*, 1927.

The theory of fluctuations applied to colloid solutions. It is pointed out that the treatment usually given, in which each particle is regarded as an independent source of scattered radiation, is based on the assumption of a completely uniform distribution of the dispersal material in space; such an assumption would not always be valid. An expression is derived, from thermodynamical reasoning, for the light-scattering power in terms of the variations of osmotic pressure and refractive index with concentration. [See also preceding Abstract.] A. D.

324. Theory of Scattering of Light in the Earth's Atmosphere. J. J. Tichanowsky. *Phys. Zeits.* 28. *pp.* 680–688, *Oct.* 15, 1927.

The author deals first with the historical development of this theory. He then considers simplified expressions and leads up to a general expression for the intensity of solar light in a given direction. The brightness of the sky for radiation of any wave-length, the colour of the sky and the magnitude of the polarisation are thus found. It also gives a solution of the dependence of the magnitude of polarisation on the height of the place of observation. With the sun in the horizon the maximum polarisation of the sky increases with the height of the place above sea-level but for an ascent above the earth's surface no change occurs. The results are compared with measurements made at Sarapul (Urals). The paper is largely mathematical. R. S. R.

325. The Filmograph Densitometer. L. Lobel and J. Lefèvre. *Rev. d'Optique*, 6. *pp.* 377–382, *Sept.*, 1927.

The filmograph densitometer is an instrument for measuring the densities of photographic negatives. It is claimed that this is the first apparatus of the kind, at a moderate price, which is easily manipulated and of good precision. A description with sketch is given, also the method of using the apparatus. This densitometer can be used for all ordinary sensitometric determinations; rapidity of sensitive surfaces, action of photographic reagents, etc. A series of graduated exercises is supplied with the instrument; these form a good introduction to the practice of sensitometry. A. E. G.

326. Desensitising. V. Sihvonen. *Z. wiss. Phot.* 25. *pp.* 1–9, *Oct.*, 1927.

Desensitising, as by phenosafranin, is a special case of sensitising in which the AgBr is the sensitiser and the dyestuff the thing acted upon. The AgBr is thus protected from decomposition; and this constitutes the desensitising of the bromide. A. D.

327. Synthetic Photo-Halide Emulsions. E. P. Wightman, A. P. H. Trivelli and S. E. Sheppard. *Eastman Kodak Co. Research Lab. Comm. No.* 309. *Frank. Inst. J.* 204. *pp.* 491–499, *Oct.*, 1927. *Phot. J.* 67. *pp.* 500–504, *Dec.* 1927.

Amendment of Lüppo-Cramer's recipe. Treatment with chromic acid to remove excess colloidal silver; lowers sensitivity; restored by very dilute ammonia. Broad spectral sensitivity; differs from that of emulsions sensitised with allyl-thiourea in being more sensitive in the red and less so in the green. Sheppard, Trivelli and Loveland's strain-ionic deformation theory supported, but Hickman's hypothesis as to the silver sulphide sensitising speck not excluded. A. D.

328. $KMnO_4$ and the Photographic Plate. J. Hrdlička. *Comptes Rendus*, 185. *pp.* 711–713, *Oct.* 10, 1927.

Exposes a plate (Lumière extra rapid, gelatino-bromide); develops; dissolves out the image (colloid silver) with acid $KMnO_4$. If the action be prolonged beyond this, a fog is produced. The sensitiveness of the plate is destroyed, and γ is greater. Concludes that acid $KMnO_4$ attacks not only the colloid silver but also Sheppard's silver sulphide specks. For the particular emulsion γ decreases with increasing intensities. A. D.

329. Ultra-Violet Absorption Measurements by Photographic Photometry. H. Ley and F. Volbert. *Zeits. phys. Chem.* 130. *pp.* 308–322, *Oct.*, 1927.

There being discrepancies between the published results by different methods, the present paper is devoted to a critical examination and comparison of the different methods in use. A new standard curve is arrived at. A. D.

330. The Parallelism of the Curves of Blackening of Photographic Plates when the Time of Exposure is Varied. E. F. M. van der Held and B. Baars. *ZS. f. Phys.* 45. 5–6. *pp.* 364–368, 1927.

The curves have been investigated with very different times of exposure, using rodinal and glycine developers. It was found that with rodinal (1 : 20) the curves are parallel even with a time ratio of 1 : 1000. H. N. A.

331. Apparatus for Automatically Recording Curves of Blackening. E. Spiller. *Zeits. Instrumentenk.* 47. *pp.* 493–496, *Oct.*, 1927. *From the Reichsanstalt.*

Registering photometers, as used for studying the intensities at various points in the breadth of lines of photographically recorded spectra, are very expensive. The paper describes an arrangement which can be built up from apparatus which exists in all research laboratories and gives good results. The optical parts and the thermo element are mounted on an ordinary optical bench, and the photographic plate is carried on the slide of a comparator, driven by a motor, and is moved at right angles to the axis of the optical system. The slide also carries the photographic plate on which the deflections of the galvanometer are recorded. H. N. A.

332. Strengthening the Latent Image. Lüppo-Cramer. *Z. wiss. Phot.* 25. pp. 23–25, *Oct.*, 1927.

Wightman and Quirk have recently published some researches on the action of H_2O_2 on the latent image in which they found that the latent image was strengthened by the action of that peroxide. The present author points out that he was led to the same conclusion as the result of experiments carried out in 1915. The priority of discovery of this effect and also the action of silver nitrate and water on the latent image is discussed. A. E. G.

333. Photochemical Destruction of the Nucleus. Lüppo-Cramer. *Z. wiss. Phot.* 25. *pp.* 25–28, *Oct.*, 1927.

Densographic curves are here given which show the effect on photographic plates which had been subject to diffuse lighting and also to the action of 1/10,000 solution of phenosafranin for two minutes, then passed into a bath of (*a*) water, or (*b*) 0·02 % KBr solution, or (*c*) 0·1 % KBr, or (*d*) 1 % KBr for two minutes and then dried. The plates were then subjected to the action of light under two different conditions specified, and subsequently developed. A. E. G.

334. Output of Fluorescence in Solutions. S. Szczeniowski. *Acad. Polonaise Sci. et Lettres*, 3*A*. *pp*. 127–174, *March*, 1927.

A method of measuring the coefficient of absorption of solutions is elaborated. This is used to measure the coefficients of fluorescein solutions. The increase with concentration is less than de Beer's law gives. A slight displacement of the maximum of absorption towards the blue is noticed at large concentrations (8×10^{-4} gm./cm.^{3}). In glycerine the absorption maximum is shifted towards the red as compared with water. Wein's law holds: similarly for the fluorescence maxima. The fluorescence output is measured and expressed as a function of exciting wave-lengths. It is found that the efficiency is independent of the concentration. There is an increase of efficiency for increase of wave-length. The absolute value of the efficiency for a concentration 4×10^{-4} gm./cm. and wave-length 5100 Å. is 0·71 for aqueous solutions and nearly 1·00 for glycerine solutions. J. E.

335. Emission of Phosphorescence. Behaviour of Samarium in Sulphides and Sulphates. R. Tomaschek. *Ann. d. Physik*, 84. 3. *pp*. 329–383, *Oct*. 18, 1927.

A continuation of previous work by the same author. In the earlier papers the author dealt with the structure of the phosphorescent spectra of the rare earths. In the present work the research is practically limited to the spectrum of samarium alone. By using high dispersion the whole spectrum was obtained. Samarium is so highly phosphorescent that if it is present as a small impurity in other metals it is clearly noted. This is investigated in the case of sulphates and sulphides of the alkaline earths. The results are incorporated in three long tables and illustrated by plates showing spectra. Full experimental details are given. S. G. B.

336. Luminescence of Mercury Vapour Excited by Electron Impacts. P. Bricout. *Comptes Rendus*, 185. *pp*. 707–709, *Oct*. 10, 1927.

A description is given of experiments made to determine, for the mercury radiation λ2536, the relation which exists between the intensity of the emitted radiation and the velocity of the exciting electrons. This relation has been called by Seeliger [Abstract 1503 (1919)] the excitation function. Special arrangements making use of a Villard alternator and a synchronous commutator enabled a sensibly constant electronic emission to be obtained from a carbon filament. A photographic method was employed to compare the radiation intensity due to various electron velocities with that due to a quartz mercury-vapour lamp operating at constant voltage and intensity. Suitable corrections were applied for the effect of (1) the initial velocity of the electrons, (2) the space charge, (3) the changes in transparency of the quartz window of the mercury-vapour chamber due to deposition of tiny drops of mercury, etc., and (4) variation of the density of the mercury vapour. Thus the excitation function was determined with a probable error of about 5 %. A. W.

337. Luminescence of Mercury Vapour Excited by Electron Impacts. P. Bricout. *Comptes Rendus*, 185. *pp.* 846–849, *Oct.* 24, 1927.

Using the method previously described [see preceding Abstract] three series of about 50 exposures were made, the electron voltage being varied from 3 to 86 volts. The measurements gave the following results: The radiation λ2536 appears suddenly at the resonance voltage (4·86 volts), and its intensity increases rapidly to a maximum at 6·5 volts; it then decreases more slowly to a value 72 % of the maximum at 10·4 volts, the ionisation voltage. When the voltage rises above this value the intensity of the resonance radiation rises rapidly again to the value at the earlier maximum and remains sensibly constant from 15 to 86 volts. Theoretical considerations give the following formula for the excitation function: $f = (C/U^2)\sqrt{(U/U_r) - 1}$, where U_r is the resonance potential, U the potential applied to the exciting electrons and C a constant. The experimental results are in good agreement with this formula. A. W.

338. Biologically Active Ultra-Violet Rays of Sunlight. L. Hill. *Roy. Soc., Proc.* 116. *pp.* 268–277, *Oct.* 1, 1927.

The radiation was measured by the acetone methylene-blue method at a number of places in England as well as in Switzerland and Egypt. It is shown that the rays producing fading in sunlight lie between λ3342 and λ3000, while the erythema-producing rays mainly lie between λ3300 and λ3000. There is a great loss of this radiation in smoky cities, and the winter readings are much lower than the summer. Davos in Switzerland, and still more Assouan in Egypt, receives a greater amount than the most favoured British place. F. S.

339. Absorption of Resonance Radiation in Mercury Vapour. A. L. Hughes and A. R. Thomas. *Phys. Rev.* 30. *pp.* 466–472, *Oct.*, 1927.

The absorption of the resonance radiation (2536 Å.) of mercury was studied by dividing the radiation from a resonance lamp into two parts, each part going into a separate photoelectric cell. An absorption cell containing mercury vapour whose pressure could be controlled by cooling a side tube was placed in the path of one beam. The ratio of the amount of light passing into each beam could be varied by a mechanical device. From the setting of the mechanical device, giving a balance between the two photoelectric currents, the absorption of the mercury vapour could be inferred. The absorption per atom was calculated and found to decrease rapidly as the total amount of absorbing vapour was increased, thus showing that the resonance radiation is not homogeneous. The maximum atomic absorption coefficient was 11×10^{-14}, which indicates that an atom can stop the radiation which falls upon an area one hundred times larger than its cross-sectional area. W. V. M.

340. The Magneto-Optical Effect and a Correction. E. Thomson. *Nature*, 120. *pp.* 581–582, *Oct.* 22, 1927.

The effect deals with the flickering seen when smoke from an iron arc is subjected to an alternating field [see Abstract 1564 (1921)]. The essence of the correction is that the flickering follows the alternations and not the cyclic changes of the field. The effect may be observed with very weak fields, and when the smoke is almost invisible, and use has been made of it to render visible to the eye the rotation of a field produced by polyphase currents. It may prove useful also for investigating the distortions in alternating fields. G. E. A.

341. Emission of Radiation by a Quadripole Electric Moment on the Quantum Mechanics. J. A. Gaunt and W. H. McCrea. *Cambridge Phil. Soc., Proc.* 23. *pp.* 930–934, *Oct.*, 1927.

The theory developed by Dirac in a recent paper [see Abstract 2496 (1927)] is shown to lead to a method for calculating the probability of switches between stationary states, corresponding to radiation by the quadripole moment of an atomic system. The probabilities derived by the usual methods of quantum mechanics represent the intensity of the dipole radiation. The method is applied to find the quadripole radiation (*a*) of a Planck oscillator, (*b*) of a rigid homopolar molecule. The intensities found are probably too faint to be observed experimentally. W. S. S.

342. The Beta Bands of Nitric Oxide. Part I. F. A. Jenkins, H. A. Barton and R. S. Mulliken. *Phys. Rev.* 30. *pp.* 150–174, *Aug.*, 1927.

These bands between the region 2300–5300 Å. have been photographed with a 21-ft. grating, using an active nitrogen source. The six branches for each of 18 bands have been measured. Combinations involving the P and R branches are found to hold, and show the existence of four different sets of rotational terms. The moment of inertia of the vibrationless molecule is given as $I'_0 = 24\cdot80 \pm 0\cdot02 \times 10^{-40}$ gm. cm.^{2} and $I''_0 = 16\cdot30 \pm 0\cdot02 \times 10^{-40}$. A. C. M.

343. Wave-Length of the Green Auroral Line. J. C. McLennan and J. H. McLeod. *Roy. Soc., Proc.* 115. *pp.* 515–527, *Aug.* 2, 1927.

The wave-length of the green oxygen line is found by comparison with iron lines, using a Fabry-Perot interferometer, to be 5577·341 Å. Babcock gives 5577·350 Å. as a mean, but he gives greatest weight to the individual value 5577·344. (These values are for the auroral line.) Consequently this is regarded as proof of the identity of the two lines. A. C. M.

344. Hydrogen Band Spectra ; New Bands in the Violet. O. W. Richardson. *Roy. Soc., Proc.* 115. *pp.* 528–548, *Aug.* 2, 1927.

These bands are very strong in the secondary hydrogen spectrum when it is excited by direct electron impact on the H_2 molecule. The present paper deals with a portion of this spectrum, and consists of Q-branches exclusively. All the bands are degraded to the violet, and each band is accompanied by a fainter component on the red side, about one-quarter of the stronger line in intensity, and about four wave numbers away from it. The final states of the bands appear to be the same as the initial states of the Lyman bands in the far ultra-violet. A. C. M.

345. Intensities in the Secondary Spectrum of Hydrogen at Various Temperatures. J. C. McLennan, H. Grayson-Smith and W. T. Collins. *Roy. Soc., Proc.* 116. *pp.* 277–312, *Oct.* 1, 1927.

Most of Merton and Barrett's lines have been measured with the microphotometer at temperatures obtained by cooling the tube with water and with liquid air. The greater part of Richardson's series system is included for which it is shown that the change of intensity with temperature is generally in good agreement with theory. Alternation of intensity between odd and even members of the series is clearly shown, and shown to be affected by temperature. Other regularities have been examined, and from the change of intensity many appear to be sequences of corresponding members of different bands rather than actual band series. F. S.

346. Bands in the Secondary Spectrum of Hydrogen. Part II. H. S. Allen and I. Sandeman. *Roy. Soc., Proc.* 116. *pp.* 312–327, *Oct.* 1, 1927.

In a previous communication [see Abstract 2049 (1927)] evidence has been given for the existence of an extensive system of bands of a distinctive type extending over a wide range of the visible and infra-red spectrum of hydrogen. These are called " Type II Bands," and are characterised by parallel groups of Q series, each group comprising three to five bands. The bands in a group are spaced out at intervals of nearly 92 wave-numbers. Various reasons have been given for ascribing the Type II Bands to tri-atomic hydrogen. In the present paper the authors have extended the study of these regular spacings. The horizontal spacing of 92 wave-numbers, which forms a prominent feature, was at first attributed to the vibration quantum number, but new evidence brought to light in the present research points to some other cause. It is suggested as a possibility that the " 92 difference " is dependent on a new quantum number which has not yet been given a specified place in the theory of band spectra. A. B. W.

347. The Infra-Red Radiation of Hydrogen. A. H. Poetker. *Phys. Rev.* 30. *pp.* 418–428, *Oct.*, 1927.

The atomic spectrum of H was investigated in the infra-red region by the photographic method. Neocyanin plates hypersensitised by an ammonia bath were used. A powerful discharge tube maintained in the so-called black stage by careful adjustments yielded under long exposures six higher members of the Paschen series, the third to the eighth inclusive. The measured wave-lengths agree with the values calculated from the Bohr theory to within the limits of experimental error. By changing the conditions of the discharge a strong molecular spectrum of H was produced. This was photographed in the region from 7500 to 10,700 Å. under a dispersion of 9 Å. per mm. The wave-lengths of about 425 lines, mostly new, were measured and are given in tables. Several of these lines seem to be members of band groups analogous to the Paschen series of the elementary spectrum. [See Abstract 1389 (1927).] AUTHOR.

348. Structure of the Atmospheric Absorption Bands of Oxygen. G. H. Dieke and H. D. Babcock. *Nat. Acad. Sci., Proc.* 13. *pp.* 670–678, *Sept.*, 1927.

Measurements made by the latter author by an interferometer method of the wave-lengths in the A, B and *a* lines were used, as these were best suited to the method. The wave-lengths are all given on the neon scale. There is evidence that some of the broadest lines may be divisible. The lines can be represented approximately by the quadratic formula $F(j) = A + Bm^2 - \beta m^4$, but for small values of j there are small but distinctive deviations in the P_2 and R_2 branch; A represents that part of the energy

(divided by h) which is not dependent on the rotational quantum number, and β is a small correction term which is due to the non-rigidity of the molecule. The constants in the formula are calculated and tabulated. The observed doublet separation can be accounted for with the terms obtained. The significance of the empirical structure of the bands for the structure of the O_2 molecule is not yet fully cleared up, but approximately the moments of inertia of the molecule in its normal and excited states are $19 \cdot 27 \times 10^{-40}$, and $19 \cdot 93 \times 10^{-40}$ respectively, giving for the distance between the nuclei $1 \cdot 205 \times 10^{-8}$ and $1 \cdot 225 \times 10^{-8}$ respectively. The electronic structure is to be discussed more fully in a later paper.
R. S. R.

349. Reversed Spectra of Metals. M. Fukuda. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 85. *pp.* 1–47, *April,* 1927. *In English.*

Fine wires or strips of the metal were exploded by a heavy current in a compressed air chamber and the spectra photographed with one of two quartz spectrographs. The metals examined were Cu, Ag, Au, Ca, Mg, Zn, Cd, Tl, Sn. Tables of wave-lengths, in many cases with series notation, are given for lines observed up to eight atmospheres pressure. The lines showed marked broadening with increased pressure and a continuous spectrum appeared. Features of the broadening were the same as for the Stark effect. Many forbidden lines appeared both in emission and in absorption. The origin of the broadening, series relations of the multiplet spectrum and the unknown lines observed are discussed. F. S.

350. Sodium and Potassium Absorption Bands. W. R. Fredrickson and W. W. Watson. *Phys. Rev.* 30. *pp.* 429–437, *Oct.*, 1927.

Formulæ for the heads of the bands are :—

Green Na_2 : $\nu = 20301 \cdot 62 + (123 \cdot 84n' - 0 \cdot 79n'^2) - (157 \cdot 57n'' - 0 \cdot 57n''^2)$
Red Na_2 : $\nu = 15006 \cdot 68 + (115 \cdot 69n' - 0 \cdot 427n'^2) - (157 \cdot 81n'' - 0 \cdot 538n''^2)$
Near red K_2 : $\nu = 15368 \cdot 63 + (74 \cdot 58n' - 0 \cdot 30n'^2) - (92 \cdot 01n'' - 0 \cdot 34n''^2)$

Since the coefficients of the n'' terms for the green and red Na_2 bands are the same, the two systems must have the same initial state (^1S) in absorption. The similarity of the green Na_2 and the near red K_2 band systems is pointed out. The n' progressions are very large for small n'' values, especially in the red Na_2 system.

A new K_2 band system has been discovered on the long wave-length side of the λ7699, 7665 K doublet. This system bears a marked resemblance to the red Na_2 bands, and is no doubt due to the same electronic transition.

The lines in the (1, 0), (1, 1), (0, 1) and (0, 2) green sodium bands have been assigned into branches by correlation with the fluorescence and magnetic rotation data of R. W. Wood. There are apparently two Q branches but only single P and R branches. An explanation of this is offered, together with the details of the agreements between Wood's data and the present analysis. The usual combination relations hold, except for a small P, Q, R " defect," which is to be expected. The K_2 bands show exactly the same structure, but no resonance series have been located with which to check the analysis. It is concluded that the green Na_2 and the near red K_2 bands are both $^1S - {}^1P$ transitions. For the initial absorption state, the moment of inertia is $7 \cdot 20 \times 10^{-39}$ gm./cm.^{2} for Na_2 and $8 \cdot 72 \times 10^{-39}$ gm./cm.^{2} for K_2. AUTHORS.

351. An Analysis of the Arc and Spark Spectra of Scandium (ScI and ScII). H. N. Russell and W. F. Meggers. *Bureau of Standards, Sci. Papers, No.* 558. *pp.* 329–373, 1927.

Spectral term combinations have been assigned to 353 lines of ScI and 142 of ScII, including nearly all the observed lines. The spark spectrum (ScII) is the simpler of the two. Using 1*s*, 3*p*, 3*d* instead of as in Bohr's notation 1_1, 3_2, 3_3 to represent the total and asimuthal quantum numbers, *s, p, d, f* taking the place of the subscripts 1, 2, 3, 4, the terms with lowest energy content are ^{3}D, ^{1}D, arising from the electron configuration 3*d* . 4*s* ; next come ^{3}F′, ^{3}P^1, ^{1}S, ^{1}D, ^{1}G from 3*d* . 3*d*. All these terms combine with ^{3}P, ^{3}D′, ^{3}F ; ^{1}P, ^{1}D′, ^{1}F, from 3*d* . 4*p*, and these again with ^{3}S, ^{3}P′, ^{3}D, ^{3}F′, ^{3}G ; ^{1}S, ^{1}P′, ^{1}D, ^{1}F′, ^{1}G from 3*d* . 4*d* and ^{3}D, ^{1}D from 3*d* . 5*s*. The last are in series with the lowest terms, and from these series the ionisation potential of the Sc$^+$ atom is 12·8 volts. A ^{3}P term arising from 4*s* . 4*p* and a ^{3}P′ term from 4*p* . 4*p* are also present. The ScI spectrum is much more complex, and a full account is given of it. Two series are found, which give the ionisation potential of the neutral Sc atom as 6·7 volts. Complete agreement with Hund's theory is shown to exist for both spectra.
H. N. A.

352. Arc Spectrum of Bismuth. G. R. Toshniwal. *Phil. Mag.* 4. *pp.* 774–787, *Oct.*, 1927.

An arc taking 20–21 amperes, and the under-water spark were used as sources, measurements of wave-lengths in the region 1900–3500 being made with quartz spectrographs. A discussion of the spectrum is given from the standpoint of theories of complicated spectra. It is shown that terms arising from the same level are separated by widely different values. A number of new lines has been measured and many important lines remeasured.
F. S.

353. Structure of the Tin Arc Spectrum. E. Back. *ZS. f. Phys.* 43. 5–6. *pp.* 309–320, 1927.

Experimental determination of the term splitting-factor *g* and the inner quantum numbers (*j*) makes possible the identification of the basic *p, s,* and *d* terms required by Hund's scheme.
A. C. M.

354. The Second Spark Spectrum of Zinc, ZnIII. O. Laporte and R. J. Lang. *Phys. Rev.* 30. *pp.* 378–386, *Oct.*, 1927.

New accurate wave-lengths of the spectrum of the high-potential spark between zinc electrodes made it possible to identify the most important line groups of ZnIII, after their positions and separations had been predicted closely by means of the screening and relativistic doublet laws respectively. The ionisation potential of the shell of ten equivalent 3_3 electrons is found to be 40 volts.
AUTHORS.

355. Band Spectra of Silicon Fluoride. R. C. Johnson and H. G. Jenkins. *Roy. Soc., Proc.* 116. *pp.* 327–351, *Oct.* 1, 1927.

The discharge through silicon fluoride is of a strong blue colour due to a system of intense bands in the blue region, degraded to the red, and as seen under low dispersion, apparently doublets. These latter are Porlezza's bands [see Abstract 2515 (1924)], but under various conditions a large number of band systems have now been obtained which are fully described in the paper. The origin of the band systems is discussed and ascribed to the silicon fluoride molecule, and not to F_2, HF, CF_4, Hg, F_2, AlF_3, or SF_6. The structures of the several separate systems are analysed at length. H. H. Ho.

356. Absorption Spectra of Coloured Borax Glasses. P. Lasareff and V. Lazarev. *Comptes Rendus*, 185. *pp.* 855–856, *Oct.* 24, 1927.

From measurements of the absorption of borax glasses coloured with copper salts, both in the strained and annealed condition, it is concluded that the coloration does not depend upon the copper ions, but upon complex compounds of copper atoms with molecules of borax. F. S.

357. Methods and Results of Intensity Measurements. L. S. Ornstein. *Phys. Zeits.* 28. *pp.* 688–696, *Oct.* 15, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

The author gives a very complete summary of recent work on this subject by a large number of experimenters. His aim is to obtain improvement in the methods used for the measurements, and questions are dealt with for which solutions have not yet been obtained. Among the subjects examined are the rules of summation in spectral series, the form of the intensities for multiplets, the Zeeman effect, the Paschen-Back effect and the Stark effect, the relations of systems with different multiplets and their intercombinations, and finally considerations regarding the constitution of the atom as revealed by these measurements. R. S. R.

358. Notes on Spectrophotometry. R. W. Ditchburn. *Cambridge Phil. Soc., Proc.* 23. *pp.* 959–969, *Oct.*, 1927.

As a source of continuous spectrum below 3200 Å., a hydrogen discharge tube of the pattern invented by Lyman is described. Currents from a 1500-volt transformer as great as 200 m.a. can be used. The methods of reducing a beam of light in a known ratio are reviewed and among the sectors is described a radial-aperture sector due to the author. The angle sensitivities of these devices are compared. F. S.

359. Multiplet Electronic States in Band Spectra. E. C. Kemble. *Phys. Rev.* 30. *pp.* 387–399, *Oct.*, 1927.

Hund's theoretical interpretation of the contracting multiplet type band spectra for diatomic molecules is thrown into quantitative form for the doublet case and also for the extreme components of higher multiplicities. The discussion is based on the conventional Bohr theory. The theory is applied to the ultra-violet doublet OH bands and is shown to be in approximate agreement with the data. F. S.

360. Some Interference Effects in the Near Infra-Red. A. M. Taylor and E. K. Rideal. *Phil. Mag.* 4. *pp.* 682–688, *Oct.*, 1927.

Describes effects which show that the ratio of transmitted to incident intensity, when thin films of crystalline substances are examined in the infra-red region, may be modified by interference phenomena. The authors have examined two plates of calcite of different thicknesses, cut perpendicularly to the optic axis, and compared the results with those of Schaefer, who used a thicker specimen. The character of the ripples obtained in the curves shows that they are due to interference; a number of bands which have formerly been ascribed to combination terms may be explained in this way. H. N. A.

361. Spectrographic Measurements in the Intermediate Region (K, L, M and N Series). J. Thibaud and A. Soltan. *Comptes Rendus*, 185. *pp*. 642–644, *Oct*. 3, 1927.

The tangential grating spectrograph [see Abstract 2930 (1927)] has been used to photograph the K lines of nitrogen and of boron, and the N doublets of Ta, W, Pt and Au, a table gives the wave-lengths in Å. and in volts, with the values of ν/R for these lines, and also for Lα of iron and M of molybdenum, with the initial and final levels in each case. For the quantum of the level L_{II-III} the values 10 volts for O, 9 volts for N, 7 volts for C and 10 volts for B were found. In the case of the N doublets the stronger component has the larger wave-length, and the final level is N_V, while that for the weaker is N_{IV}. The starting level in each case is O. Differences between the results and those of Dauvillier, who employed as " grating " a fatty acid, are ascribed to refraction at the surface of this substance. It is possible to calculate from these differences the refractive index of the substance employed. H. N. A.

362. Zeeman Effect in the Ångström CO Bands. E. C. Kemble, R. S. Mulliken and F. H. Crawford. *Phys. Rev*. 30. *pp*. 438–457, *Oct*., 1927.

The qualitative features of the Zeeman effect on the band lines of rigid diatomic molecules as given by the conventional quantum theory and the new quantum mechanics are the same. Precise values of the size of the pattern are given. Measurements have been made of the Zeeman effect in the 5610, 5198, and 4835 bands of CO, the results being in agreement with the theoretical predictions. The effect is proportional to the field strength, and the patterns are symmetrical about the positions of the lines with no field. Eight of the possible twelve patterns observable for the first two lines of the P and Q bands have been resolved, the rest together with all of the patterns for R(1) and R(2) being too faint for observation. The higher Q lines appear as doublets in the parallel polarisation, and broad singlets in the perpendicular polarisation. The P and R branches in the two polarisations show a similar but reversed and less pronounced difference in character. The theory does not explain the greater intensity of the low-frequency component of the Q doublets and of the high-frequency components of the P doublets (perpendicular polarisation). The results confirm the Mulliken theory of the CO Ångström bands. W. V. M.

363. Anomalous Multiplets and Intercombinations in the Spectrum of OII. F. Croze and C. Mihul. *Comptes Rendus*, 185. *pp*. 702–704, *Oct*. 10, 1927.

After a brief reference to work of Fowler [see Abstract 1334 (1926)] on this subject the authors give tabulated data relating to their own investigations. A short abstract of this data would be unsatisfactory—the original paper should be consulted. A. B. W.

364. Zeeman Effect in the Cerium Spectrum between 3000 and 5000 Å. H. Margenau. *Phys. Rev*. 30. *pp*. 458–465, *Oct*., 1927.

Some 300 lines of the Ce spectrum have been observed and a qualitative interpretation of the patterns on the basis of the Landé-Sommerfeld theory presented. A great number of lines having the appearance of sharp triplets in the field have been found, and it is shown that the strongest combinations of regular terms in Ce would give such patterns. To explain the types observed it is necessary to use (1) displaced terms, and (2) in some cases displaced terms and cross-system combinations. The evidence obtained is in favour of F. Hund's prediction that the fundamental term of Ce is a ^3H term. A number of lines which probably belong to the ionised atom are tabulated. W. V. M.

365. Reflecting Power of the Carbon Atom for High-Frequency Rays. M. Ponte. *Phil. Mag.* 4. *pp.* 232–233, *July*, 1927.

A corrected calculation making allowance for the density of an impure powder. This gives $f_c(111) = 2\cdot6$. The accuracy is not more than 15 %. For the original paper see Abstract 1424 (1927). J. E.

366. The Absorption of X-Rays and the Multiple Ionisation of Atoms. L. M. Alexander. *Phil. Mag.* 4. *pp.* 670–681, *Oct.*, 1927.

Determines the mass absorption coefficient of a number of different elements throughout a range of wave-lengths. These were plotted for each element against λ^3; for aluminium a single continuous straight line was obtained for the range of wave-lengths employed, while with copper there were two straight lines, CuK and CuK′, with different slopes, intersecting at $\lambda = 0\cdot628$ Å., the KK′ break; K′ corresponds to shorter wave-lengths and K to longer, and for all elements the slope for the K′ absorption is steeper than that for the K. Evidence for the existence of the break is deduced from the results of other investigators. $\sqrt{\nu/R}$ at the KK′ break was plotted against the atomic numbers, and the law $\nu/R = 1\cdot5Z^2$ deduced. The paper deals with the general laws of absorption, and explains the KK′ break as being the point where the quantum of impinging radiation has just enough energy to remove the two K electrons as a single act; evidence is given in support of this view. H. N. A.

367. Modified and Unmodified Scattered X-Rays. (J-Phenomenon—Part VII.) C. G. Barkla and S. R. Khastgir. *Phil. Mag.* 4. *pp.* 735–745, *Oct.*, 1927.

It is shown that a scattered radiation which is a modified radiation when intercepted by one substance is an unmodified radiation when intercepted by another substance. This result holds throughout the whole spectrum experimented upon, from low frequencies to high frequencies, even including the K absorption edge of the absorbing substance. The experiments, therefore, show that the evidence of transformation of a radiation by scattering depends upon a relationship between the scattered radiation and the material used to test the radiation. "In any one substance the modified and unmodified scattered radiations are alternative results obtained when there is not the slightest indication of variation in other substances. More important still, the unmodified and the modified scattered radiations as measured in different substances frequently are one and the same radiation unless a radiation may be regarded as changed when the substance placed in its path is changed." The deductions are contrasted with those of A. H. Compton and shown to differ fundamentally theoretically. A. B. W.

368. A Vacuum Spectrograph and its Use in the Long X-Ray Region. J. Shearer. *Phil. Mag.* 4. *pp.* 745–753, *Oct.*, 1927.

A description of a windowless spectrograph and some results of the use of a cone sugar crystal for measurements in the long-wave region.

The results of Dauvillier are criticised since the author failed to find any photographic action through 10^{-4} cm. of Al foil or Schumann films placed in the direct beam, using a peak voltage of 340 and 30 milliamp.-minutes exposure. W. V. M.

369. Multiple Ionisation in X-Ray Levels. H. R. Robinson. *Phil. Mag.* 4. *pp.* 763–774, *Oct.*, 1927.

A discussion of the lines due to multiple ionisation in the X-ray levels of atoms—called by Wentzel X-ray " spark " lines. Wentzel's scheme of transitions is criticised and various modes of production of doubly-ionised states considered. The importance of " corpuscular " spectra is also pointed out. F. S.

370. X-Ray Energy Levels for Elements from Antimony (51) to Samarium (62). Katherine Chamberlain and G. A. Lindsay. *Phys. Rev.* 30. *pp.* 369–377, *Oct.*, 1927.

The three L absorption edges and certain adjacent emission lines of the same element were photographed, thus giving a direct measurement of the distances from the $L\beta_2$ line to the L_{III} edge, from $L\gamma_1$ to L_{II} and from $L\gamma_4$ to L_I from which the N_{IV}, N_V and $O_{II\text{-}III}$ energy levels were determined accurately. Particulars are given on making absorbing screens containing free antimony, tellurium and iodine, and with these the L_1 absorption edges for Sb(51), Te(52) and I(53) were 2631·7, 2503·9 and 2383·9; L_{II} edges at 2821·9, 2679·3 and 2547·5; and L_{III} edges at 2990·7, 2845·7 and 2713·9 X-units respectively. The variation with atomic number of the values of the N_{IV}, N_V and $O_{II\text{-}III}$ energy levels are discussed in detail. W. H. Gr.

371. X-Ray Diffraction in Liquids. Primary Normal Alcohols. G. W. Stewart and R. M. Morrow. *Phys. Rev.* 30. *pp.* 232–244, *Sept.*, 1927.

The view is here taken that there is in liquids a molecular space array, called " cybotaxis." Evidence of this array is given for primary normal alcohols. Two parameters are found, the first dependent on the number of C atoms and the second almost independent of this. The latter is taken as the separation between the chains. This distance varies from 3·8 Å. with methyl to 4·6 Å. with lauryl alohol. The 4·6 Å. is in agreement with Adam's work on surface films of saturated fatty acids [see Abstract 390 (1923)]. The increase of the first distance is 1·3 Å. per carbon atom in agreement with Müller and Saville [see Abstract 1557 (1925)]. Comparison of spacings with the solid state shows that the phenomena are not due to crystalline particles. The bearing of the theories of Raman and Ramanathan and of Debye is discussed. J. E.

372. X-Ray Liquid Diffraction. C. M. Sogani. *Indian Journ. Phys.* 2. *pp.* 97–132, *Sept.*, 1927.

Fourteen liquids, including fatty acids, pyridin derivatives and mercury added to the 21 of [Abstract 2926 (1927)]. Some of the acids have also been exposed in the solid state. Diffractions for all the substances tabulated. The molecular constitution of liquids is discussed, and it is shown that the molecules in a liquid must not only be distributed in a fairly regular manner as regards spacing, but must also influence the orientation of their neighbours to a considerable extent if their shape departs considerably from spherical symmetry. A general discussion of X-ray haloes in liquids having (1) elongated molecules, (2) flat molecules, and (3) molecules in which the distribution of the scattering electrons is very unsymmetrical. Both in (1) and (2) we have, in general, two maxima in the diffraction pattern, corresponding to the two principal dimensions of the molecules. In (3) the cross-section, in (2) the linear dimensions of the flat surface of the molecules will be the more prominent in the halo. A detailed attempt is made to explain the structures of the diffusion-haloes for all the liquids (35 in number) investigated in the light of the general discussion for the typical cases (1), (2) and (3). A. D.

RADIOACTIVITY.

373. Ionisation by Radon in Spherical Vessels. G. Glockler. *J. Phys. Chem.* 31. *pp.* 1322–1331, *Sept.*, 1927.

The ionisation produced by radon as calculated by the average path method of Lind [see Abstract 271 (1913)] is compared with that calculated by the method of Mund [see Abstract 2881 (1926)]. For spherical vessels having a diameter up to 10 cm., the two methods give similar results which also agree with the experimental value obtained by Lind. A new derivation of Mund's equation is given, but the assumption made by Mund that the whole of the radium-A and -C decomposes on the vessel wall is modified. From the experimental value of Lind and Bardwell [see Abstract 559 (1924)] for the average path (0·61 × radius of the reaction vessel) it is calculated that 30 % of the radium-A and 7 % of the radium-C decompose in the gaseous phase. Mund's efficiency factor is recalculated on this basis. L. M. C.

374. Regularities of Radioactive Change. W. A. Sokolow. *ZS. f. Phys.* 45. 5–6. *pp.* 409–415, 1927.

Previous work is first discussed following which a connection is established between the disintegration constant and the number of the radioactive element in the disintegration series (not to be confounded with the atomic number). Those elements which deviate from this relationship are found to possess certain common characteristics. Between the disintegration constant of the β-radiator and the position of the radioelement in the series a relationship has now been found. H. H. Ho.

375. Grouping of Radioactive Atoms in Acid Solutions and on Surfaces activated by Emanation. (Miss) C. Chamié. *Comptes Rendus*, 185. *pp.* 770–772, *Oct.* 17, 1927.

Groups of radioactive atoms were formed on evaporating solutions of polonium chloride and nitrate, and of the active deposit of thorium on the surface of mica or on a greased photographic plate, and on activating a sheet of mica by exposure to thorium emanation. The earlier observations on the surface of mercury [see Abstract 2556 (1927)] were not therefore of a specific property of this element. T. M. L.

376. Retardation of α-Rays by Matter. S. Rosenblum. *Comptes Rendus*, 185. *pp.* 851–853, *Oct.* 24, 1927.

In a previous paper the author gives a formula for the retardation of α-rays in a number of metals [see Abstract 2631 (1926)]. He now gives the revised formula $X = K(u - u^2 . 10^{-2} + 35{\cdot}5u^3 . 10^{-6})$, where K is a function which depends on the nature of the screen. A table gives the values of K determined for a number of different metals. Experiments with alloys of gold and silver and of silver and copper show that the law of additivity holds approximately. Curves are given for a number of different metals. X is the weight of the absorber in mg. per cm.^{2} and $u = 100(V_0 - V)/V_0$, where V_0 is the initial velocity of the α-rays of thorium C employed and V their velocity after passed through the screen. H. N. A.

377. Absorption of β-Rays by Matter. G. Fournier. *Ann. de Physique*, 8. *pp*. 205–277, *Sept.–Oct*., 1927.

Contains fuller details of the author's work on the subject [see Abstract 2633 (1926)]. In the case of compounds it has been found that some follow the additive law, while this is not the case with others. The author suggests that this is due to a difference in the strength of the bonds between the atoms in the two cases. When this is small, the absorption takes place practically as though the atoms were independent of one another; when, however, the bonds are very strong, the group of atoms may absorb the β-rays in much the same way as a single heavy atom, and the additive law does not hold. H. N. A.

378. Absorption and Reduction in Velocity of β-Rays on their Passage through Matter. E. Madgwick. *Cambridge Phil. Soc., Proc*. 23. *pp*. 970–981, *Oct*., 1927.

After considering the theory due to Thomson and Bohr, an apparatus is described for measuring the ranges of β-rays in aluminium, the rays being bent with a semi-circular path by a magnetic field. Experiments were also carried out on copper, tin and lead. These gave progressive deviation from the linear law of absorption due to increasing scattering effect. The distribution of intensity in a displaced and broadened β-ray line was investigated also. The results lend strong support to the general truth of theory. F. S.

379. β-Ray Spectrum of RaE. E. Madgwick. *Cambridge Phil. Soc., Proc*. 23. *pp*. 982–984, *Oct*., 1927.

The spectrum was investigated with the same apparatus used in previous work [see preceding Abstract], various fields being employed. The continuous spectrum has been compared with those of Ra*C* and Th (*B* + *C*). Values of Hρ for maxima and end points are given. F. S.

380. The Amount of Energy Emitted in the γ-Ray Form by Radium E. G. H. Aston. *Cambridge Phil. Soc., Proc*. 23. *pp*. 935–941, *Oct*., 1927.

The heating method of determining the energy, which has been used for radium B and radium C, cannot be employed for radium E, since the γ-ray energy is much smaller in this case. The author has determined limits between which this energy must lie by comparing the ionisation produced by radium E with those produced by radium B and radium C. A knowledge of the relation between ionisation and wave-length is necessary for accuracy, but the fact that the ionisation decreases as the wavelength decreases can be made use of in obtaining limits for radium E, since its effective wave-length lies between those of B and C. It was found that the γ-ray energy of radium E escaping through 1 mm. of lead lies between 2500 and 7600 volts per atom disintegrating. Another method gave 2600 volts. Taking 6000 volts and an initial value before passing through the lead of 10,000 volts, only one γ-ray quantum is emitted during about thirty disintegrations. It is suggested that the origin of these γ-rays may be in the retardation or collisions of the β-particles from the nucleus. H. N. A.

381. Internal Conversion of γ-Rays. Bertha Swirles. *Roy. Soc., Proc.* 116. *pp.* 491–500, *Oct.* 1, 1927.

The internal conversion of γ-rays has been investigated experimentally by Ellis and Wooster [see Abstract 2089 (1927)]. The present paper is a mathematical treatment of the problem on the lines of the quantum mechanics. The problem is that of the perturbation of a hydrogen atom of nuclear charge z by a Hertzian doublet at its centre. An expression is obtained for the coefficient of absorption in the K levels. This expression gives values about one-eighth smaller than the experimental values, but the discrepancy is probably due to a neglect of the screening by the other electrons. A. B. W.

382. Photographic Action of H-Rays. Part II. Marietta Blau. *Akad. Wiss. Wien, Ber.* 136. 2*a*, No. 7. *pp.* 469–480, 1927.

Describes an improved apparatus for photographing the tracks of natural H-particles, by means of which a large number of distinct rectilinear rows of points has been obtained. It is shown that these points (excited silver bromide grains) are not as close together for H-rays as for α-rays. The length of the lines observed depends on the residual range of the H-particles where they strike the photographic plate, but only a fraction of the H-particles of short range can be recognised by rows of points. Using the retrograde method, H-rays from disintegrated atoms can be shown to exist, and form lines of points in the photographic plate. The method is not adapted to the cases of gold and diamond on account of the strong luminescence produced in these cases, but with other forms of carbon, beryllium and aluminium results are obtained which agree with those of the scintillation method, and confirm the disintegration of carbon. [See also Abstract 155 (1927).] H. N. A.

HEAT.

383. Thermal Conductivity of Light Alloys. C. Grard and J. Villey. *Comptes Rendus*, 185. *pp.* 856–858, *Oct.* 24, 1927.

A number of alloys of aluminium and magnesium with copper have been investigated, and it is found that the difference in conductivity of the two pure metals decreases with the proportion of copper added. The mechanical properties of such alloys are also discussed. F. S.

384. Measurement of the Thermal Conductivities of Metals. Method of the Point of Stationary Temperature. P. Vernotte and M. Pellegrin. *Comptes Rendus*, 185. *pp.* 844–846, *Oct.* 24, 1927.

Kohlrausch showed that if an electric current I is applied to a bar of a metal, giving a potential difference e between its two extremities and a difference of temperature ν between the middle of the bar and its ends, then the ratio of the thermal to the electrical conductivity is given by $k/\sigma = e^2/8\nu$. No account was taken, however, of the lateral loss of heat or of the variations of k and σ with the temperature. The present authors show that if V is the temperature at the point x, then at the point of stationary temperature at the middle of the bar, where $dV/dx = 0$, the equation at the steady state may be written $-sk_0(d^2V/dx^2) + H_0 - \frac{I^2}{s\sigma_0} = 0$. By means of a second experiment, preferably with the bar equally heated at the two ends and with no current flowing, H_0, the heat dissipated per unit area at the mid-point, may be eliminated, the gradient d^2V/dx^2 evaluated, and hence the value of $k_0\sigma_0$ determined. Results have thus been obtained to a degree of accuracy of 1 % for bars of aluminium and magnesium alloys, the values referring to a fixed temperature, namely that at the middle of the bar. T. B.

385. Thermal Expansion of Cobalt-Nickel, Cobalt-Iron and Iron-Nickel Alloys. A. Schulze. *Phys. Zeits.* 28. *pp.* 669–673, *Oct.* 15, 1927 *From the Reichsanstalt.*

In the continued investigation [see Abstract 203 (1928)] specimens prepared in the same way are placed in tubes of Jena glass 59^{III} and tested by the method of Henning [see Abstract 1020 (1907)]. The thermal expansion curve of Ni-Co alloys for the interval 20 to 100° C. shows the three maximum peaks of the electric conductivity curves corresponding to Ni_4Co, NiCo and $NiCo_4$, but the second peak is slightly displaced and somewhat uncertain. Similar peaks are observed in the Co-Fe alloys, but the peaks are turned downward and the curves are less regular. The iron-nickel alloys were made by the Glockenstahlwerk A.G., annealed at 900° C. and slowly cooled. As iron is being added to nickel, the expansion decreases and reaches a minimum for invar. When nickel is added to iron, the expansion first decreases to a low value (25 % Ni) and then rises abruptly to a sharp maximum (30 % Ni), already observed by Guillaume, but not otherwise confirmed, from which it falls almost to zero (near 40 % Ni) to increase again. The alloy of maximum expansion, probably Fe_2Ni, is unmagnetic at ordinary temperature, and such sudden changes in the expansion curves were so far unknown in crystallised compounds which are not ferromagnetic. H. B.

386. Copper-Constantan Thermocouples and the Hydrogen Thermometer compared from 15° to 283° Absolute. W. F. Giauque, R. M. Buffington and W. A. Schulze. *Am. Chem. Soc., J.* **49.** *pp.* **2343–2354,** *Oct.,* **1927.**

The employment of copper-constantan thermocouples as secondary thermometric standards for low-temperature calorimetric and other measurements is justified. Full experimental details are appended of the method of testing the thermocouples for use at low tempertaures. The calibration of Cu-constantan thermocouples over the temperature range 15 to 283° K. against standard couples and also the hydrogen-gas thermometer is described, the results indicating the limits of accuracy of such thermocouples. The gas thermometer employed could be maintained at $\pm 0{\cdot}01°$ for a time sufficient for the experiments at any temperature from ordinary air temperature down to that of liquid hydrogen. A table showing the characteristics of a typical Cu-constantan thermocouple from 25° K. to 283° K. is included. S. G. B.

387. Hydrogen Gas Thermometer compared with the Oxygen and Hydrogen Vapour-Pressure Thermometers by Means of a Copper-Constantan Thermocouple. W. F. Giauque, H. L. Johnston and K. K. Kelley. *Am. Chem. Soc., J.* **49.** *pp.* **2367–2372,** *Oct.,* **1927.**

A comparison of the oxygen and hydrogen vapour-pressure thermometers with the standard thermocouple of Giauque, Buffington and Schulze. Complete agreement, within the limits of accuracy, was found with the Leiden scale at the temperatures of liquid oxygen. The Cu-constantan thermocouple was found to differ from the hydrogen vapour pressure measurements below 25° K., probably due to adsorption of H in the gas thermometer. Tables are appended showing the behaviour of a Cu-constantan thermocouple below 30° K. The triple-point pressure of H was found to be 5·370 international cm. of Hg, and combined with the Martinez and Onnes values for vapour pressure gives a triple-point temperature of 13·92° K. The vapour pressure of solid hydrogen is dicusssed and an expression given. S. G. B.

388. Suggested New Base Point on the Thermometric Scale and the $\alpha \rightleftarrows \beta$ Inversion of Quartz. F. Bates and F. P. Phelps. *Bureau of Standards, Sci. Papers, No.* **557.** *pp.* **315–327,** *Aug.,* **1927.**

The $\alpha \rightleftarrows \beta$ inversion of crystalline quartz has been studied in a variety of ways which are described and which culminated in the X-ray work of Bragg and Gibbs. The bearing on the general theory of allotropy is important. The present paper describes an attempt to measure the rotation of plane polarised light by crystalline quartz at high temperatures and the hysteresis found in the heating and cooling rotation curves. Experimental details are given for the investigation of the so-called heating and cooling curves for crystalline quartz. The temperature at the transition point was held constant for some time to investigate the nature of the inversion. Superheating and supercooling accompany the transition. The temperature of commencement of inversion, as also the exact transition point, was well defined in both heating and cooling, and the heat of transition at the inversion temperature was calculated. In a variety of quartz samples examined, the temperatures at which inversion started on heating were identical and perfectly definite, *viz.*, 573·3° C. This fixed and definite temperature occurred with great sharpness and is suggested as a new base point on the thermometric scale, as well as for standardisation of and checking thermocouples. S. G. B.

389. Adiabatic Microcalorimeter for Radiological Researches. W. Swietoslawski and A. Dorabialska. *Comptes Rendus*, 185. *pp.* 763–765, *Oct.* 17, 1927.

The calorimeter is suspended in a thick-walled copper container which can be evacuated. The apparatus is placed in a thermostat. The temperature-rise in the calorimeter is determined by a thermocouple and galvanometer arrangement, and is balanced by raising the temperature of the thermostat so that the galvanometer needle is kept at zero. The apparatus has an error of 0·7 % for radiological determinations and can be used to measure any continuous thermal effect. L. M. C.

390. A Theory of the Specific Heat, the Latent Heat of Fusion and Vaporisation being taken into Consideration. U. Doi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 91. *pp.* 129–147, *July*, 1927. *In English.*

The principal merit of Planck's theory as explained by Einstein [see Abstract 439 (1907)] lies not so much in its agreement with observation as in its having established a possibility of extending the application of the quantum theory to the domain of the thermal energy of a material body. Debye, from a consideration of the elastic properties in conjunction with Einstein's theory, solves the problem of the specific heats of non-gaseous substances, and the present author now attempts a quantum theoretical treatment of the subject from the standpoint of the latent heat which accompanies change of state. The paper is entirely mathematical and tentative in its objective. H. H. Ho.

391. The Specific Heats of Solid Substances at the Temperatures Attainable with the Help of Liquid Helium. I. Measurements of the Atomic Heat of Lead. W. H. Keesom and D. H. Andrews. *K. Akad. Amsterdam, Proc.* 30. 4. *pp.* 434–443, 1927. *Comm. No.* 185*a from the Phys. Lab. Leiden.*

The atomic heat of lead is determined between 2° K. and 20° K. The only measurements of the specific heat previous to these are those of K. Onnes and Holst on mercury [see Abstract 320 (1915)]. A constantan coil is used for heating as well as for the measurement of temperature. No indication is found of a discontinuous change in the atomic heat at the transition to the superconductive state. The atomic heat at the lower temperatures is much greater than that calculated from the formula of Debye. It seems likely from the measurements that the atomic heat capacity approaches zero near 0° K., but at a considerably smaller rate than the T^3 rule of Debye would lead one to expect. At 3° K. the value of the atomic heat is about 0·2. T. B.

392. The Specific Heat of Water Vapour and the Theory of the Dissociation of Water Vapour at High Temperatures. W. H. McCrea. *Cambridge Phil. Soc., Proc.* 23. *pp.* 942–950, *Oct.*, 1927.

At temperatures near 100° C. there is polymerisation, which produces a minimum near the beginning of the C_v curve, but becomes negligible at higher temperatures. Callendar's equation of state is used in calculating the effect due to the association of the water-vapour molecules. Shilling's minimum is more pronounced than that thus found and cannot be explained by the above method; the author has attempted to find an explanation for this, but has failed to do so. The vibrational specific heat has been calculated from the two fundamental frequencies known from band spectra data and the third, for which Dennison has suggested a value $\nu_3 = 21 \cdot 720 \times 10^{13}$. The calculated values are given in a table and shown in a graph; they lie much below the observed values for high temperatures. The theory of the dissociation of H_2O is worked out and formulæ are obtained for the percentage dissociation and the heat of formation at any temperature, so that the amount to be added to the vibrational specific heat could be determined. The final results, with the exception noted above, agree well with Shilling's experimental results.

H. N. A.

393. Freezing Points of Concentrated Solutions. Part II. E. R. Jones and C. R. Bury. *Phil. Mag.* 4. *pp.* 841–848, *Oct.*, 1927.

This work was undertaken with the object of obtaining reliable values for the activities of a few typical, associated substances in aqueous solution. The experimental methods have been fully described previously [see Abstract 2324 (1927). The results are given in a series of tables which show for formic acid, acetic acid, propionic acid and butyric acid, (*a*) the concentration in mols. per 1000 grammes of water, (*b*) depressions of the freezing point of water, and (*c*) the activity coefficients. Acetic acid is a typical weak acid, and its solutions obey Ostwald's dilution law up to concentrations of 1/10th normal, or considerably higher if the conductivities are corrected for change of viscosity; but the assumption that activity is proportional to the concentration of unionised molecules is far from true even in hundredth normal solutions. Butyric acid is remarkably abnormal, *i.e.*, its activity coefficient changes rapidly with concentration. These two results are discussed and explanations of them are suggested.

A. E. G.

394. Theoretical Solution of the Heat-Exchange Problem during the Circulation of a Non-Viscous Liquid with Flow Potential in the Interior of a Tube. A. Lévèque. *Comptes Rendus*, 185. *pp.* 886–889, *Oct.* 31, 1927.

In this mathematical paper the cases are treated of a cylindrical tube of circular section and of flow between two parallel plates, the velocity being considered uniform in a straight section and the temperatures of liquid and boundaries also uniform. It is assumed that the velocity is such that the influence of temperature differences upon it is negligible.

H. H. Ho.

395. Experiments on the Rate of Evaporation of Small Spheres as a Method of Determining Diffusion Coefficients. The Diffusion Coefficient of Iodine. B. Topley and R. Whytlaw-Gray. *Phil. Mag.* 4. *pp.* 873–888, *Nov.*, 1927.

In this paper an experimental method is described for utilising the rate of evaporation as a means for the determination of diffusion coefficients. The examples chosen are those of freely suspended spheres of volatile material. The calculation of the diffusion coefficient of the vapour and

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the correction for the self-cooling of the sphere are discussed. The diffusion coefficient of iodine vapour in air has been measured over the temperature-range from 10° to 30°, and tables of data are included.
H. H. Ho.

396. Temperature and Energy of a Gas. E. Wertheimer. *ZS. f. Phys.* 45. 3–4. *pp.* 231–260, 1927.

Generalisation of the equation $u' = \phi(v) \, . \, T$, given earlier [see Abstract 405 (1927)] for very rarefied gases, to the case of all gases; and $\phi(v) = \text{constant} \, . \, T_s^s$, where T_s is the boiling point at the volume v and the exponent s varies with the nature of the gas. A. D.

397. Vapour Pressures of Diphenyl and of Aniline. F. J. Garrick. *Faraday Soc., Trans.* 23. *pp.* 560–563, *Sept.*, 1927.

The results obtained for diphenyl are not in agreement with those of Jaquerod and Wassmer, which showed an anomaly, a sharp change of slope appearing at about 224° C. when T_1/T_2 is plotted against T_1, where T_1 and T_2 are the absolute temperatures at which diphenyl and mercury have the same vapour pressure. The author's curve shows no such discontinuity. The results with aniline do not agree with those of Kahlbaum. The Ramsay-Young graph shows a smooth curve, and is nearly continuous with that of Beckman and Liesche. H. N. A.

398. Vapour Pressures of Liquid Mercury. A. W. C. Menzies. *Zeits. phys. Chem.* 130. *pp.* 90–94, *Oct.*, 1927. *In English.*

In previous measurements of the vapour pressure of mercury, published by Smith and Menzies in 1910, the boiling point of sulphur was taken as 445° C. The temperature scale then employed has now been revised, and the vapour pressures of mercury have been corrected so as to conform to the new value for the boiling point of sulphur: 444·6° C. By the aid of new measurements, the constants for the Kirchhoff-Rankine-Dupré Hertz equation have been evaluated, and the deviations between the calculated and observed values only differ by 0·10 %. F. J. B.

399. Connection between Specific Radiation Intensity and Radiation Density. W. Alexandrow. *Phys. Zeits.* 28. *p.* 555, *Aug.* 1, 1927.

Consideration of this subject as dealt with in the literature is now shown to reveal the presence of a well-known proposition of the potential theory, *viz.*, the flux hypothesis for the vector $-\operatorname{grad} \phi$ with $\phi = \int 1 \, . \, dv/r$ (or the hypothesis of Gauss: $-\int \frac{\partial \phi}{\partial n} d\sigma = 4\pi \int 1 \, . \, dv = 4\pi v$). This result is also general for the case of radiation anisotropy. H. H. Ho.

400. A Correction to the Paper "The Experimental Basis of the Third Law of Thermodynamics and its Generalisation." N. v. Kolossowsky. *ZS. f. Phys.* 44. 9–10. *p.* 756, 1927.

In the above paper [see Abstract 2732 (1927)] it was erroneously stated that $\lim \, (d \ln p/dT)_{T=0} = 0$, whereas in reality this condition does not follow from the equation $\lim \, (dp/dT)_{T=0} = 0$. Accordingly, the conclusion must be drawn that the consideration of the course of the vapour pressure curve is not suitable for the general proof of the Nernst heat theorem, but is only valid for the case of a degenerated gas which at absolute zero has a finite volume. Certain formulae are also rendered invalid by the above correction. H. H. Ho.

401. Entropy at Infinite Pressure and the Equation of State of Solids. G. N. Lewis. *Zeits. phys. Chem.* 130. *pp.* 532–538, *Oct.*, 1927. *In English.*

In this investigation of the properties of substances under high pressure it has been convenient to consider the force acting upon an atom in the presence of other atoms as the resultant of attractive and repulsive forces, of which the latter diminish more rapidly with increasing distance than the former. The principle is then advanced that at all temperatures the entropy of a pure crystal is zero at infinite pressure, and this gives a powerful means of extrapolating existing data. Illustrative results are given for potassium, sodium and lithium, and a tentative equation of state for solids is described. H. H. Ho.

402. Gaseous Combustion at High Pressures. Part VIII. Explosion of Methane with up to its Own Volume of Oxygen at Initial Pressures up to 150 Atmospheres. D. T. A. Townend. *Roy. Soc., Proc.* 116. *pp.* 637–663, *Nov.* 1, 1927.

The results are given of a systematic study of the behaviours on explosion of (1) a number of methane-oxygen mixtures between the limits $5CH_4 + 2O_2$ and $CH_4 + O_2$, and (2) of mixtures corresponding with $CH_4 + O_2 + 3{\cdot}76R$ ($R = N_2$, Ar or He). [See Abstract 1434 (1915).] Although at atmospheric pressure it is not possible to explode methane with less than two-thirds of its own volume of oxygen, at high pressures mixtures containing far less oxygen can be readily exploded. Increasing the initial pressure in exploding mixtures containing upwards of 60 % of methane results, not only in an increase in the violence of the explosion, but also in a diminution and sometimes in the entire prevention of the deposition of carbon. These results are probably due to the influence of pressure in suppressing the thermal decomposition of methane. Contrary to its behaviour in the explosion of carbon monoxide-air mixtures, nitrogen is not "activated" in the explosion of a $CH_4 + O_2 + 3{\cdot}76N_2$ mixture, but appears to behave normally as a mere diluent. In comparison with that of argon, the influence of helium in the explosion of $CH_4 + O_2 + 3{\cdot}76R$ mixtures is to shorten the time taken for the attainment of maximum pressure, as well as to increase the subsequent rate of cooling, these effects being accounted for by the greater mobility of the helium molecule. The corrected values of the ratio of the maximum to the initial pressure are, however, always greater for the argon-diluted mixtures. These results furnish general confirmation of the earlier observations and show that the mode of combustion of methane in explosions at high pressures accords well with the hydroxylation theory of hydrocarbon combustion. T. H. P.

SOUND.

403. Sound Waves of High Frequency. S. R. Humby. *Phys. Soc., Proc.* 39. *pp.* 435–442; *Disc.*, 442–443, *Aug.*, 1927.

Interference and diffraction effects of sound waves of frequencies above 4000 per second can be studied quantitatively by using as source a telephone energised by current from a valve circuit, and as detector either the ear or sensitive flames responding to points of maximum air density variation or to maximum motion of the air. An acoustic analogy to certain Heaviside layer experiments is described. W. H. Ge.

404. Struck String. R. N. Ghosh. *Indian Journ. Phys.* 2. *pp.* 29–50, *Sept.*, 1927.

Records some observations on the deflection of a Rayleigh disc tuned to the fundamental of the struck string when the initial speed of the hammer is kept constant whilst the position of the impact is varied. Other experiments and points are discussed, but full details of all the required constants of the apparatus are not always given, so that it is not clear to what some of the results refer. W. H. Ge.

405. Absorption of Ultra-Sonic Waves by Hydrogen and Carbon Dioxide. T. P. Abello. *Nat. Acad. Sci., Proc.* 13. *pp.* 699–701, *Oct.*, 1927.

While measuring the velocity of very high frequency waves in CO_2 Pierce [Abstract 341 (1926)] found that the gas absorbs these waves strongly. Experiments here described confirm this result and also show that hydrogen absorbs such waves more than air. The experiments are being continued, and further results will be published later. A. W.

406. The Structure of Sounds and their Perception. U. Bordoni. *Elettrotecnica*, 14. *pp.* 733–741, *Oct.* 5, *and pp.* 758–769, *Oct.* 15, 1927.

In the first part of this paper the structure of sounds is considered. The characteristic magnitudes of energy and harmonic analysis and synthesis are first dealt with, and then the importance of "accessory sounds," the individuation of acoustic structure, and "acoustic spectra." Then the acoustic spectra of musical sounds, the acoustic structure of language and "characteristic zones of frequency" are considered. The general conclusion that may be drawn from the examination of the series of various acoustic spectra which are reproduced is that for the reproduction or correct transmission of musical sounds or of language it is in no way sufficient to take account only of the reproduction or transmission of the fundamental frequencies corresponding to the restricted intervals of action of the instruments and to the moderate extension of the human voice. It is absolutely necessary besides to consider the frequencies considerably higher that correspond to the accessory tones (determining the *timbre*) or to the "formative zones." Later is discussed from the quantitative side the consequences brought on, from the point of view of the correct intelligibility of sounds and above all of language, by a reproduction or a transmission which may be limited to an insufficient interval of frequency.

The second part of the paper deals with the perception of sounds. The limits of perceptibility, the normal audiogram, and the representation of the defects of perception are first considered ; then the sensibility of the ear to differences of intensity, the laws of Weber-Fechner, the measurement of the intensity of the auditive sensations, the sensibility of the ear to differences of pitch, minimum duration necessary for the perception, simultaneous perception of more than one sound, intensity of the sensations produced by complex sounds, are described ; and next notes are given on the anatomical structure of the ear and on the functioning of the internal ear, the non-linearity of the relation between " external stimulus " and " internal stimulus," and on additional excitations of subjective origin. Finally, some account is given of the acoustic spectrum of language, the influence on " comprehensibility " of the suppression of determined zones of frequency, and the influence of energy intensity.

J. J. S.

407. Resonance in Pipes Stopped with Imperfect Reflectors. E. T. Paris. *Phil. Mag.* 4. *pp.* 907–917, *Nov.*, 1927.

The theory of pipes stopped with imperfect reflectors is discussed, and the conditions for resonance are deduced. Some special cases are dealt with, including that of a Boys pattern double resonator, and the conditions necessary for complete absorption (*i.e.*, no reflection) of sound by a resonator placed at the end of a stopped pipe are found. Some of the results obtained have an application to the theory of the measurement of sound absorption by the stationary-wave method. AUTHOR.

408. The Open-End Correction of a Square Organ Pipe. S. A. Higgs and L. C. Tyte. *Phil. Mag.* 4. *pp.* 1099–1125, *Nov.*, 1927. *Supplement.*

In 1860 Cavaillé-Coll, a French organ-builder, showed that the sum-total of the lip and open-end corrections to the length of an organ pipe was 2*b*, where *b* is the depth of the pipe. In 1877 R. H. M. Bosanquet found that the end correction for a square iron pipe 5 in. long and of 2 in. side was 0·44*b*. This pipe was without flange. Rayleigh has calculated the correction for the open end for cylindrical pipes having an infinite horizontal flange to be between 0·82 R and 0·78 R, where R is the radius, the flange having the effect of increasing the end correction by 0·2 R. Bosanquet later gave the more correct value of 0·25 R for the increase in effective length due to the flange. The authors of the present paper have investigated how far Rayleigh's analogy with the problem of electrical resistance holds good in the case of square organ pipes. They found that the value of the open-end correction for a square organ pipe was 0·809 ± 0·001 times *b*. As to Rayleigh's analogy between the acoustical and electrical problems, it appears that a linear relation exists between them, and allowing for the open-end correction the value in the acoustical case is directly proportional to its electrical equivalent. The experiments have shown that the shape of the flange very close to the opening is very important, suggesting that the transition from the plane waves inside the pipe to the spherical waves which travel out into free space takes place rapidly and very near the opening, at a short distance from which the waves have taken up their final form. J. J. S.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

409. Method of Drawing Equipotentials and Lines of Force. K. Kurokawa. *Inst. El. Eng. of Japan, J. No.* 470. *pp.* 934–955, *Sept.*, 1927.

The equipotentials and lines of force of a charged strip are confocal ellipses and hyperbolas where the foci are at the ends of the strip. If the equations of these curves are expressed in polar coordinates, other curves can be obtained from them by taking roots of the vectors, and all curves thus obtained will be such as to give systems of lines intersecting at right angles so that they again represent equipotentials and lines of force. The author shows how this method of taking roots of the vectors can be employed for finding the field of complicated charged figures. R. O. K.

410. Dust Electricity. P. Böning. *Zeitschr. f. tech. Phys.* 8. 10. *pp.* 385–398, 1927.

The appearance of free electric charges in matter in a finely divided state in gases may be traced, according to many observations and the researches arranged by the author himself, to two occurrences which have an underlying causal connection with the observed facts: these are collision and disintegration. Similar causes are found in the case of electricity developed by friction. J. J. S.

411. Surface Tension and Electric Charge. E. Bogoslowsky. *Ann. d. Physik*, 84. 2. *pp.* 323–326, *Oct.* 4, 1927.

Comments are made on certain errors in the calculations and observations of Ruff, Niese, and Thomas on charged drops in electric fields. [See Abstracts 2114, 2115 and 2116 (1927).] J. J. S.

412. The Electrical Condition of Hot Surfaces during the Adsorption of Gases. Part I. Gold and Silver Surfaces at Temperatures up to 850° C. G. I. Finch and J. C. Stimson. *Roy. Soc., Proc.* 116. *pp.* 379–400, *Oct.* 1, 1927.

This investigation was undertaken with the object of confirming and extending Hartley's work [see Abstract 1318 (1914)]. It has been found that a gold or silver surface becomes charged when heated either in contact with a gas or in a high vacuum, the charge being characteristic of the gas and dependent on temperature but not on pressure. Evacuation of a gas removes the corresponding charge slowly in the case of oxygen or air on gold, and oxygen, air or hydrogen on silver, but rapidly in the case of the other gases examined. The influence of variations in the rates of evacuation on the charges has been studied and also the effects of gas mixtures. Previous heat treatment of the surface has a profound effect on its powers of activation. It is concluded (1) that the charge on a hot gold or silver surface in contact with a gas is due to an "activation" of the gas, whereby its molecules become electrically charged; and that (2) the activation of a compound molecule such as water vapour or carbon dioxide involves at least its dissociation.

H. H. Ho.

413. On Electrets. E. P. Adams. *Frank. Inst., J.* 204. *pp.* 469–486, *Oct.*, 1927.

A study of the "permanently" polarised dielectrics formed by allowing melted wax to solidify in an electric field, and described by Eguchi. It is shown that the polarisation really decays slowly with the time, and this decay accounts in part for the free charges on opposite faces which are observed. The rate of decay appears to increase very rapidly with the temperature, and the polarisation may be completely destroyed even when the waxes are not softened. The electrets are shown to behave as pyroelectric bodies; they also exhibit the piezoelectric effect. H. N. A.

DISCHARGE AND OSCILLATIONS.

414. A Mercury-Vapour Lamp. Belleaud and Barrollier. *Rev. d'Optique*, 9. *pp.* 383–386, *Sept.*, 1927.

A brief account of the chief drawbacks to old-fashioned mercury-vapour lamps is first given; then with the aid of sketches the principle and advantages of the Belleaud and Barrollier lamp are set forth. The chief advantages appear to be: (1) The lamp does not deteriorate with use; (2) digression from usual routine does not appear to injure it; (3) it can be moved with safety even when the arc is working; (4) there is no polarity. A. E. G.

415. Concentrated Mercury-Arc Lamp. E. L. Harrington. *Phil. Mag.* 4. *pp.* 836–840, *Oct.*, 1927.

A mercury-arc lamp in which the arc was confined to a capillary tube was described in a previous communication [see Abstract 326 (1924)]. This lamp has now been improved, both limbs of the U being made alike, so that an interchange in the position of the two limbs can be made when one has become discoloured and the transparency to ultra-violet light is thereby reduced. Specimens of the mercury-arc spectrograms taken with the improved lamp and with the non-concentrated mercury-arc lamp are given, together with spectrograms showing the difference in the mercury spectrum with different wattage and with pyrex glass or quartz for the construction of the lamp. F. J. B.

416. New Type of Low-Voltage Mercury Arc. A. Bramley and W. B. Nottingham. *Frank. Inst., J.* 204. *pp.* 487–490, *Oct.*, 1927.

In this paper a new type of mercury kathode or anode is described which consists essentially of a device for allowing mercury droplets to fall from one mercury reservoir, the kathode or anode as the case may be, to another used as the anode or kathode. A diagram of the device is given. When the p.d. between the kathode and anode is sufficient—in the tube described above 300 or 400 volts, according to the direction of the applied field—a discharge commences whose current fluctuates with the same period as that of the falling drops, as the resistance of the tube decreases markedly each time a drop falls through the field. The falling drops are also surrounded by a bright mercury glow, showing that intense ionisation occurs around the surface of the drop. A. E. G.

417. Connection between Sparks, Brush Discharges and Arcs. M. Toepler. *Arch. f. Elektrot.* 18. *pp.* 563–566, *Sept.* 21, 1927.

A discussion, chiefly mathematical, on the observations which have been made on this subject. J. J. S.

418. Discharges and Discharge-Tube Characteristics. W. Clarkson. *Phil. Mag.* 4. *pp.* 849–866, *Oct.*, 1927.

An account is given of discharges in gases up to half an atmosphere, the positive column being present. The gases used were air, nitrogen, or argon-nitrogen mixture in a dry, though not a pure, state. Later experiments have proved that the results apply equally well to pure gases. It was found possible to obtain discharges of two kinds: "flashes" in which the characteristic was only finally reached, and discharges in which the characteristic itself was traversed, only dynamic equilibrium being attainable in the former type. An examination of discharge-tube characteristics proved that discharges of quite unique appearance were associated with each stage at whatever pressure. A condenser discharge is considered as a jump from the "corona" characteristic to the "stable" characteristic, "build-up" occurring from the first and "clear-up" beyond the second. The characteristic is thus considered as a statical boundary between two regions where only dynamic equilibrium is possible. "Threshold current" phenomena and "clear-up" effects are discussed, and are employed to explain dynamic sparking potentials. The various ways in which a discharge can become steady are developed and the problem of "extinction" considered. Application is made to discharges of many kinds. A. W.

419. Optical and Electrical Study of the Formation of Metallic Layers by Kathodic Sputtering. A. Andant. *Rev. d'Optique*, 6. *pp.* 364–376, *Sept.*, 1927.

Earlier experiments on the formation of metallic layers by kathodic sputtering had been made by withdrawing the layer from the apparatus for each optical or electrical measurement. The method is lengthy and gives results which do not refer to the same metallic layer, formed without interruption under rigorously comparable conditions. The author gives details of an apparatus by means of which he could follow quickly variations of the optical density and electrical resistance of the metallic layer during sputtering. The values obtained for the sputtering of Pt in air are tabulated and shown graphically. The following conclusions are drawn: (1) The optical density increases linearly at first with the duration of sputtering, next decreases and tends finally to a limiting value, but quite at the start of the sputtering the difficulty of measuring the very feeble optical density does not permit any conclusion being drawn; (2) the electrical resistance of the layer, infinite or very large in the early stages, increases very rapidly with the duration of sputtering, then increases and tends finally also to a very small limiting value; (3) beyond a certain thickness the metallic layer formed seems to oppose any further increase and opposes the sputtering; (4) for small optical densities it is better to employ a feeble current intensity for a long time and for opaque layers to use a very intense current for a short time. Further tests are to be made with other metals and with copper in such gases as H_2, N_2 and CO_2. R. S. R.

420. Characteristics of Gasfilled Photoelectric Cells. N. R. Campbell. *Phil. Mag.* 4. *pp.* 726–735, *Oct.*, 1927.

As in the case of the intermittent neon-lamp discharge [see Abstract 2368 (1927)] the author shows that the gasfilled photoelectric cell is characterised by upper and lower critical voltages. On this basis three different methods of using the cells are described and the frequency of intermittence determined. The primary object of the present investigation was to provide some theoretical basis for the methods of using gas-filled cells described in a previous paper. Although this object has not been achieved, certain doubtful points have been cleared up. It is undesirable to reduce the capacity of the insulated electrode to a minimum —the capacity should be the least that gives *regular* intermittence. The method is stated to be " unrivalled in convenience when very small illuminations have to be measured." A. B. W.

421. The Velocity and Number of the Photoelectrons ejected by X-Rays as a Function of the Angle of Emission. E. C. Watson. *Phys. Rev.* 30. *pp.* 479–487, *Oct.*, 1927.

Magnetic spectra of the electrons ejected by X-rays from thin metallic films at angles ranging from 0° to 180° with the direction of the X-ray beam have been obtained by the method of Robinson, de Broglie, and Whiddington. To the degree of accuracy of the measurements (one-half of 1 %) the maximum velocity of ejection is exactly the same in all directions. With thin foils of the heavier elements the number of electrons leaving the foil with this maximum velocity in the various directions (determined by the intensity of the edges) is approximately the same. With radiators of small density, or with sputtered films so thin that Wentzel's criterion for " single " scattering holds, the number of electrons leaving the foil is greatest in a direction a little forward of perpendicular to the direction of the X-ray beam. Rutherford's theory of nuclear scattering applied to electrons gives an explanation of these results if the assumption is made that all the electrons start out from the atom in the same direction. AUTHOR.

422. Direction of Photoelectron Emission. D. H. Loughridge. *Phys. Rev.* 30. *pp.* 488–493, *Oct.*, 1927.

Photographs of the photoelectron tracks in a Wilson expansion chamber through which a narrow beam of monochromatic MoKα X-rays were passed were taken with a stereoscopic camera. The direction of the paths with respect to the X-ray beam was determined from measurements made with a specially designed stereoscopic comparator. 445 tracks were studied, of which 231 were in argon, 123 in air and 91 in hydrogen. Curves showing the frequency of occurrence of different angles of ejection have a fairly sharp maximum for angles of about 70° with the forward direction of the X-ray beam. The curves are similar for the three gases studied except that the maximum in the case of hydrogen is somewhat sharper than for the other two gases. [See also Abstract 755 (1926).] AUTHOR.

423. Reflected and Secondary Electrons from an Aluminium Target. J. B. Brinsmade. *Phys. Rev.* 30. *pp.* 494–500, *Oct.*, 1927.

Velocity distributions of secondary electrons from an aluminum target, bombarded with homogeneous streams of primary electrons, were examined with a magnetic analyser. The secondaries examined were those coming off approximately at right angles with the primary beam. The range of primary velocities used was from 5 volts to 175 volts. Sharply defined peaks, consisting of electrons reflected without loss of energy, constitute 2 % of the whole distribution at 175 volts, 10 % at 35 volts, 90 % at 12 volts, and 95 % at 7 volts. The coefficient of reflection at right angles is of the order of 10^{-3} to 10^{-2} per unit solid angle, increasing over twenty-fold between 100 volts and 8 volts, attaining a maximum at 7 or 8 volts and decreasing sharply below that. AUTHOR.

424. Direction of Ejection of X-Ray Electrons. E. C. Watson and J. A. van den Akker. *Nat. Acad. Sci., Proc.* 13. *pp.* 659–662, *Sept.*, 1927.

No conclusive evidence that the direction in which photoelectrons are ejected by X-rays depends in any way upon the nature of the atom from which the ejection takes place has as yet been brought forward. Auger, using the C. T. R. Wilson cloud expansion-chamber method, showed that the most probable direction of ejection in a gas is a function of the frequency of the incident X-rays, but the variations which he found in this most probable direction with the nature of the gas used (oxygen, or nitrogen, argon, krypton, xenon) were probably less than the experimental error, particularly as heterogeneous X-rays were used, and the frequency of the X-rays which were most effective in ejecting electrons may have varied from gas to gas. Loughbridge concluded that the most probable direction of ejection was the same for water vapour, air and argon, but the absorption energies of even the K-shells of all these atoms is so small that at best only a small effect would be expected in these cases. Bothe, using the point-discharge ion-counter, made observations on air and on gases the molecules of which contained I, Br and Cl atoms. His results show small variations with the nature of the gas, but as heterogeneous X-rays were used and his maxima were not sharp the variations were probably less than the experimental accuracy. It is now concluded that the momentum of the electron in its orbit within the atom does not affect the direction of ejection in the way demanded by the theory of Auger and Perrin. While this does not constitute definite evidence against the physical reality of electronic orbits, it is a serious difficulty for the conception. [See also Abstract 3184 (1927).] A. E. G.

425. Correction of Work on "Proof of Monomolecular Ions in Air and the Existence of Action at a Distance between Ion and Gas Molecule." W. Busse. *Ann. d. Physik*, 84. 2. *pp.* 327–328, *Oct.* 4, 1927.

H. Schilling has recently shown by using the net condenser method and with thorough drying that mobility of ions can only rise to 2·45 cm. per sec./volt per cm., corresponding to an ion magnitude of nearly threefold molecular diameter. The flaw in the author's measurements must therefore be traced to other conditions, probably changing unequal distribution of ion concentration. [See also Abstract 449 (1927).] A. E. G.

426. Duration of the Existence of Doubly Charged Positive Ions in Gases, and their Detection. L. B. Loeb. *Nat. Acad. Sci., Proc.* 13. *pp.* 703–707, *Oct.*, 1927.

Statements made in recent articles dealing with the problems of ionisation indicate that it is still the belief that doubly charged positive gas ions, having the same mobility as singly charged ions, exist and have been detected in gases, even after considerable periods of time. The conclusion drawn from the present discussion is that while ionisation processes occasionally generate multiply charged ions in gases, the number of these is very small even in the most favourable cases, and it is very unlikely that they will exist in the gas in the multiply charged state over a period of time such as to be studied as doubly charged ions under the conditions of ordinary ionic experiments. With this state of affairs it is essential that results on which a statement of the existence and detection of doubly charged positive ions is made are carefully scrutinised.

A. E. G.

427. Ionisation by Collision. L. G. H. Huxley. *Phil. Mag.* 4. *pp.* 899–902, *Nov.*, 1927.

In a previous paper [Abstract 3181 (1927)] Taylor replied to remarks on his "photoelectric theory of sparking" made by the present author [Abstract 2375 (1927)]. Huxley here considers Taylor's objections to Townsend's theory of sparking and criticises them, reference being made to various results discussed in Townsend's "Electricity in Gases."

A. W.

428. Differential Retarding Potential Method for the Study of the Energy Distribution of Slow Electron Emissions. C. F. Sharman. *Cambridge Phil. Soc., Proc.* 23. *pp.* 922–929, *Oct.*, 1927.

The apparatus used consists of two precisely similar structures for impinging a beam of electrons on a target and collecting the secondary electrons against a retarding potential, arranged in such a way that each is the mirror image of the other. In the plane of mirror symmetry is mounted the tungsten-emitting filament which serves as the common electron source for both apparatus. The currents between the targets and their respective collectors, for the same retarding potential, are first carefully balanced out. A small extra retarding potential is then introduced in one apparatus and the out-of-balance current measured. This method enables the energy distribution law of the secondary electrons to be determined with considerable precision. Using copper targets, the results establish the existence of a maximum frequency of secondary electrons at a finite small energy, shown to be independent of the energy of the electrons of the primary beam over a fairly wide range. Tungsten evaporated from the emitter filament was found to be deposited on the copper target in a steadily thickening layer, and corresponding changes in the energy distribution of the secondary electrons could be traced.

W. S. S.

429. Secondary Emission from Mo due to Bombardment by High-Speed Positive Ions of the Alkali Metals. W. J. Jackson. *Phys. Rev.* 30. *pp.* 473–478, *Oct.*, 1927.

Work has been extended to measurements on secondary emission from Mo due to the bombardment of positive ions of Na^+, Rb^+ and Cs^+ following the method used for K^+ and described in detail in a previous paper [see Abstract 446 (1927)]. Confirmatory evidence is obtained that heat treatment in general reduced the secondary emission. With degassed targets the following results were obtained: Na^+ ions showed a positive ion reflection of 3 % or 4 % independent of the speed of the impacting ion and electron emission of about 2 % at 1000 volts. Experiments with Rb$^+$ indicated a reflection of positive ions of less than 2 % and no electron emission within the experimental error. Cs$^+$ gave a secondary emission of about 9 % at 1000 volts. It is suggested that the relatively large secondary emission from an untreated target as compared with a well-degassed metal is possibly due to the minimum distance of the electron from the metal surface being greater in the former than in the latter case; also if secondary emission is due to local high temperatures arising from positive ion bombardment, there would be more rapid dissipation of energy by the target surface than by the gas molecules. AUTHOR.

430. Space Charge as a Cause of Negative Resistance in a Triode and its Bearing on Short-Wave Generation. L. Tonks. *Phys. Rev.* 30. *pp.* 501–511, *Oct.*, 1927.

The mathematical theory of negative resistance in both the plate and grid circuits of a triode has been worked out. Negative resistance is found when a virtual kathode is formed between the grid and plate. In general this requires a plate voltage low compared to the grid voltage, a minimum electron current density depending upon the voltages used, and proper electrode spacing. For plane parallel construction the plate-grid distance must exceed the grid-kathode distance, and for cylindrical construction the ratio of plate to grid diameter must exceed 2·15. Typical theoretical plate and grid characteristics are plotted. Failure of the experimental verification of these static characteristics through the occurrence of oscillations is not unexpected in view of the short relaxation time of the triode. Applied to the short wave oscillations discovered by Barkhausen and Kurz [see Abstract 908 (1920)], this theory, in combination with that proposed by Gill and Morrell, is able to explain their main features. AUTHOR.

431. Resonant Circuits with Reactive Coupling. R. T. Beatty. *Phil. Mag.* 4. *pp.* 1081–1098, *Nov.*, 1927. *Supplement.*

A mathematical discussion limited to the subject of amplification over a linear region of the characteristic curve and under conditions where the grid current is negligible—that is, the amplification is without distortion. The problem is simplified without using approximations by the introduction of equivalent circuits, and a representation by means of curves derived from a parabola is given, by help of which the behaviour of the circuits can be ascertained by inspection. The geometry of the parabola is used to facilitate the discussion of amplification and resonance curves, and two new terms—" tolerance " and " activity "—are introduced with the object of supplying a quantitative basis for the treatment of selectivity. J. J. S.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

432. Equation of Electronic Conduction in Unipolar Non-Metallic Films. F. M. Gentry. *Science*, 66. *pp.* 284–285, *Sept.* 23, 1927.

The equation for the variation of the current flowing through a unipolar non-metallic film due to electronic conduction when the film is in intimate contact with a metal can be derived from the use of Poisson's potential equation, in a manner similar to the method used by Langmuir in studying the effect of the space charge on the emission of electrons from hot filaments. It is here considered best to write the equation in the form $I = kE^{3/2}$ for given dimensions of the film and for a given temperature. The constant *k* can then be determined empirically. When this equation is tested from the data previously obtained experimentally by Grondahl, who has made measurements on the current flowing in both directions through a copper oxide film on a copper disc, it is found that the agreement is about as good as can be expected. The derivation of the equations given in this paper are based upon the theory of this phenomenon suggested previously by Grondahl. A. E. G.

433. Dielectric Constants in Very Dilute Electrolyte Solutions. A. Deubner. *Ann. d. Physik*, 84. 3. *pp.* 429–456, *Oct.* 18, 1927.

Apparatus described, based on Drude's first method, and working to 1 part in 1000 for water, 2 or 3 per 1000 for strong solutions. Sources of error considered. Measurements for pure water, sugar, NaCl, $CuSO_4$. A new source of error is found in a change of values occurring when a good-conducting solution is left for some time in contact with metal. The results are in accordance with those of Hellman and Zahn [see Abstract 1872 (1927)], by the decrement method; not with those of Sack [see Abstract 2139 (1927)], by the Nernst method, who finds much greater depressions. A. D.

434. Dielectric Constants of Binary Mixtures. Application of the Method of Partial Molal Quantities. J. W. Williams and J. H. Mathews. *Zeits. phys. Chem.* 130. pp. 277–285, *Oct.*, 1927. *In English.*

A mathematical expression is derived for the capacity produced when a mole of liquid is placed between parallel plates 1 cm. apart. This quantity is termed the molal inductive capacity. Two methods of treatment which have been used for dielectric constant data of binary liquid mixtures are reviewed and their limitations briefly discussed. A third method for binary systems, utilising the concept of partial molal quantities, is suggested, and its possibilities are outlined. A calculation for the association factor of ethyl alcohol is made, using dielectric constant data for the system ethyl ether—ethyl alcohol, and the concept of the molal inductive capacity and the corresponding partial quantities. The treatment of the subject is entirely mathematical. [See Abstract 2761 (1927).] E. F.

435. Dielectric Constants of Binary Mixtures. Benzene as a Solvent for Certain Solid Substances. J. W. Williams and R. J. Allgeier. *Am. Chem. Soc., J.* 49. *pp.* 2416–2422, *Oct.*, 1927.

Dielectric constant and density data are obtained for benzene solutions of benzoic acid, phenol, iodine, stannic iodide, antimony tri-iodide and silver perchlorate. By means of the Debye modification of the Clausius-Mossotti law these data are used to calculate the electric moments of the various solute molecules. The results of these calculations are discussed with particular reference to the conceptions of atomic structure and to solubility relationships. The experimental data are tabulated. E. F.

436. High-Tension Voltmeter. O. Klemperer. *Phys. Zeits.* 28. *pp.* 673–674, *Oct.* 15, 1927.

The instrument depends for its action on the attraction of two spheres raised to the voltage to be tested, this force of attraction being resisted by a spring. The movement of one sphere is observed through a microscope, while the other sphere is fixed in position. The movable sphere is supported by a bifilar suspension and its movements damped by having a metal disc supported below the sphere and moving between the poles of a powerful magnet. For a spring of length l and a movement of the sphere through a distance Δz the relation is found $Q = (4p \cdot \Delta z/l) + (8q \cdot (\Delta z)^3/l^2)$, where p and q are constants for the instrument and can be determined for known voltages. The instrument gives an accuracy of 1 % for a range between 5000 and 80,000 volts.

R. S. R.

437. Bellati's Dynamometer. A. Pfeiffer. *Ann. d. Physik,* 84. 3. *pp.* 395–428, *Oct.* 18, 1927.

A Bellati dynamometer [Bellati, Atti del R. Ist. Ven. 1. p. 563 (1883)] of very high sensitiveness is described. The principle of the instrument is simple. An elongated body of soft iron, such as a piece of wire, is placed in the magnetic field of a coil with its axis of length at 45° to the direction of the field. When the coil is traversed by a current the field component parallel to the axis of length of the iron causes magnetisation, the perpendicular component merely deflecting; and since upon commutation of the direction of current both the magnetising and deflecting force change their effects, the throw of the instrument is independent of the direction of current. The natural use is for the measurement of alternating currents. The author reviews shortly researches hitherto carried out by means of Bellati's dynamometer, and refers to Gilthay's simple theory. Gans' theory of reversible permeability is applied to the instrument. Its behaviour in the presence of permanent magnetism in movable masses of iron with the action of external magnetic fields as well as its behaviour towards continuous currents are explained. Two methods of overcoming or lessening the magnetic disturbances of the dynamometer are described. An increase of the sensitiveness of the instrument is obtained through raising the susceptibility of the iron and lessening the demagnetisation, *i.e.*, through raising the " apparent " susceptibility of the moving iron body; and also by raising the apparent susceptibility with simultaneous lightening of the moving system. This object is also attained by the use of a sensitive Bellati system with a ring-shaped coil containing iron. A form of the instrument free of eddy currents is described and its behaviour with high frequencies considered. A wattmeter of high sensitiveness is described.

J. J. S.

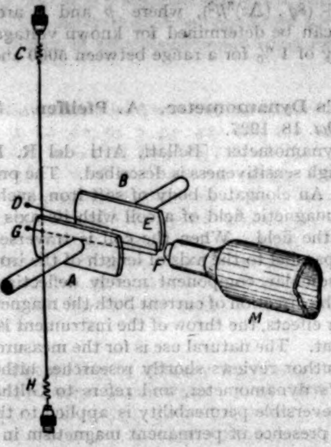
438. The Alternating-Current Bridge as a Harmonic Analyser. I. Wolff. *J.O.S.A. and R.S.I.* 15. *pp.* 163–170, *Sept.*, 1927.

A description is given of a simple impedance bridge and auxiliary apparatus for the measurement of the total harmonic content of an alternating electric current. Total harmonic content is defined as the ratio of the square root of the sum of the squares of the harmonic amplitudes to the amplitude of the fundamental. This quantity is determined by a comparison of two resistances. The bridge may also be used for the determination of the amplitude of large individual harmonics of low order. Details are given of the method of use.

J. J. S.

439. New Type of String Electrometer: New Method of Preparing Quartz Fibres. E. Perucca. *Zeits. Instrumentenk.* 47. *pp.* 524–527, Nov., 1927.

Describes a modification of the Lindemann electrometer, the principle of which is shown in the figure. By the introduction of the loop DEFG the sensitivity can be greatly increased, for the end F can be brought very close to the microscope objective without undue disturbance of the electrical field by the nose of the microscope. With a fibre of 0·007 mm. diam., a magnification of 100, 16 volts between the plates and a separation of



20 mm., a sensitivity of 0·005 volt per scale division can be obtained with a range of stability of ± 50 scale divisions. In an Appendix to the paper the author describes a new and convenient method of making long and very fine quartz fibres. J. W. T. W.

440. Application of the Electrometer to Industrial Measurements. J. Villey. *J. de Physique et le Radium*, 8. *pp.* 397–421, *Oct.*, 1927.

In arrangements without an insulated system, in which the electrometer is used instead of a voltmeter, and in cases with an insulated system where alternating e.m.f.'s are employed, serious errors due to very small accidental alterations of insulation need no longer be feared, and practical industrial applications of the electrometer may be considered. It can be used when a derived circuit, even though very small, is inadmissible, as in the case of ionisation currents. Its use is interesting with alternating currents, as, *e.g.*, the differential measurement of very high resistances, and above all with high-frequency oscillations. For the differential measurement of coefficients of electric induction it can be employed with sensitiveness equivalent to that of interferential methods. The author has devised a new type of simplified electrometer, with a view to industrial applications, which is yet of sufficiently high sensitiveness. The quadrants are replaced by four threads parallel to the suspending fibre, and the needle has the form of a very elongated plane rectangle, of which the principal axis of symmetry is a prolongation of the suspending fibre. Hopkinson's electric directing couple is negative, and the total directive couple may be reduced to a somewhat small fraction of the torsion couple. In industrial installations this type of electrometer has been associated with an electric dynamometer with a deformable condenser, of which practical details are given. In movable installations, in particular on vehicles of all sorts, where the electrometer cannot be used, dynamometers, accelerometers and manographs with deformable condensers can be employed by making use of the method of beats of Hertzian oscillations. J. J. S.

441. Determination of the Capacity of Electrometers. Part II. H. Witte. *Phys. Zeits.* 28. *pp.* 651–661, *Oct.* 1, 1927.

Tests further the method described in Part I [see Abstract 2766 (1927)], using instead of the dummy electrometer previously employed an electrometer from which the movable parts could be taken out. The uncertainty inherent in the method is smaller than the error which arises when the instrument is not carefully arranged in the high-frequency circuit. When the capacity is determined by the statical methods of Harms or Wulf the value is higher than that obtained by the high-frequency method. Using, however, a method by means of which statical and high-frequency measurements could be made without alteration to the apparatus the differences vanished. H. N. A.

442. Use of the Compton Electrometer for Measuring Charge. E. G. Cox and G. C. Grindley. *Journ. Sci. Instruments*, 4. *pp.* 413–416, *Oct.*, 1927.

The relation between sensitivity to charge and sensitivity to voltage of the Compton electrometer is discussed. Considerations of a general character indicate that a high voltage sensitivity is not necessarily accompanied by a correspondingly high sensitivity to charge. The results of an experiment are given in which a twenty-sevenfold increase in voltage sensitivity was accompanied by a 50 % increase in sensitivity to charge. AUTHORS.

443. A Method of Measuring Variations of Electrical Resistance for the Determination of the Thermal Equilibrium Diagram of an Intermetallic System. F. H. Jeffery. *Faraday Soc., Trans.* 23. *pp.* 563–570, *Sept.*, 1927.

The resistance was measured between two thin molybdenum leads, which dipped into the alloy, two different methods of recording being used, one with two Callendar recorders with which the change of resistance with time of cooling and the variation of temperature with time of cooling were measured ; in the other method two observers are needed, and a screen covered with squared paper moving upward with uniform velocity, as designed by Heycock, was used. The light spot from the galvanometer fell on this screen, and a resistance-time curve could be traced upon it ; from this a curve giving change of resistance as a function of temperature could be deduced. The method has been tested with copper-tin alloys from 40 atomic per cent. to 98 atomic per cent. tin. The lines in the thermal equilibrium diagram agree in the main with those of the Heycock and Neville diagram, but the Isihara line did not appear. H. N. A.

444. Measurement of Electromotive Force of Microscopically Small Elements. R. Fürth. *Phys. Zeits.* 28. *pp.* 697–698, *Oct.* 15, 1927. *Paper read before the Deut. Physikertag, Kissingen, Sept.*, 1927.

In a triode valve the gap from anode to kathode forms one arm of a Wheatstone bridge, the other arms having two fixed and one variable resistances, and balance is obtained when no current flows past the grid.

The e.m.f. to be measured is then inserted in the grid circuit and balanced against that along a potentiometer. With this arrangement practically no current flows from the element tested. Values of 10^{-4} volts can be measured without complicated arrangements or costly apparatus. Examples are given of these tests. It is shown that the purity of metals or metallic surfaces can be tested by this method. R. S. R.

445. Potentiometer Arrangement for Extending the Range of E.M.F. Measurements. C. D. Miller. *J.O.S.A. and R.S.I.* 15. *pp.* 238–245, *Oct.*, 1927.

The arrangement described by the author, which may be used in connection with either a potentiometer or a voltmeter (the degree of accuracy being, in each case, that of the instrument employed), is briefly as follows: Two accurately adjustable resistances or resistance boxes, R and P, are connected in series with each other and a p.d. of suitable amount is applied to their extreme terminals. Another set of resistances, A and B, also connected in series, is placed across the terminals of R, and the p.d. across R is determined either by a potentiometer or a voltmeter. Finally, the source of unknown e.m.f. is connected in series with a galvanometer and across the terminals of A, so as to enable the unknown e.m.f. to be balanced against the p.d. across A. By varying the ratio $A/(A + B)$, any desired fraction of the p.d. across R may be applied across A; while by changing the ratio R/P balance may be obtained in the galvanometer circuit.

A. H.

446. Measurement of Mutual Induction. M. Masius. *Zeits. Instrumentenk.* 47. *pp.* 439–440, Sept., 1927.

An account of a modification of the method of Pirani and Carey Foster for the measurement of a mutual induction by comparison with a capacity. This method gives sensitiveness with simple apparatus. J. J. S.

ALTERNATING CURRENTS AND MAGNETISM.

447. The Skin Effect in Iron Conductors. K. A. Mittelstrass. *Arch. f. Elektrot.* 18. *pp.* 595–615, *Sept.* 21, 1927.

It was sought to apply the theory of Arkadiew relating to the electromagnetic field in ferromagnetic metals to the distribution of current in an iron conductor conveying an alternating current with technical frequencies. This is only possible when in the range of field strength concerned both the magnetic permeability μ and the magnetic conductivity ρ are at least approximately constant. It was established that as μ so also ρ with change of H passes through a maximum which occurs approximately at the same field strength. In the neighbourhood of this maximum, where μ and ρ depend only slightly on H, the theory mentioned may be applied. Within this region of field strength the distribution of current in an iron conductor of large cross-section was measured at frequencies of 2–4 periods per second by means of the method given by Busch [see Abstract 376 (1926)] with the help of applied sounds. At the same time this distribution of current was calculated theoretically, and theory and measurement were in agreement that hysteresis comes into action, that the amplitude of the current density decreases more strongly from the outside inwards, and the shifting of phase of the individual current lines towards each other is smaller than that given by the theory which takes no account of the hysteresis losses. J. J. S.

448. Eddy Currents in Thin Circular Cylinders. F. W. Carter. *Cambridge Phil. Soc., Proc.* 23. *pp.* 901–906, *Oct.*, 1927.

This is a mathematical paper dealing with the eddy currents in thin circular cylinders of uniform conducting material, due to periodic currents in conductors lying parallel to the axis of the cylinder, or to the rotation of the cylinder in a two-dimensional field of force. J. J. S.

449. Magnetic Testing of Welded Joints. A. Roux. *Comptes Rendus*, 185. *pp.* 859–861, *Oct.* 14, 1927.

The tests are made by placing the sheet iron to be examined on the square pole-pieces of an electromagnet, covering the sheet iron with paper and strewing iron filings on the paper. When the seam is at right angles to the lines of force and free of defects, these lines appear continuous. The two cases illustrated by photographs of the filings, fixed by gum, represent defective welds, the iron being really welded only on one surface or on both surfaces, but not throughout the metal; the line of welding is then marked by an accumulation of filings. H. B.

450. Magnetism and Temperature in Crystals. W. Peddie. *Roy. Soc. Edinburgh, Proc.* 47. 2. *pp.* 165–176, 1926–1927.

Equating the energy of an ideal magnet to the mean translational energy per degree of freedom in the thermal motions of a magnetic crystal, a generalised equation of thermomagnetic state is derived. Polar curves are drawn for particular cases, in which the radius represents the component of magnetisation taken transverse to the external field, which is along the radius, the discussion being confined to cubic crystals. The general equation is then modified, and families of curves are drawn giving the magnetisation at different inclinations to the edge of the cube. These curves are hyperbolas, and include straight lines for the directions of the binary and quaternary axes. The equation of state is then put into a form which, like van der Waals' equation, can be employed for "corresponding temperatures," so that by its means the thermomagnetic properties of any crystal can be found when those of another have been determined, along with the critical constants of both, namely, the critical temperatures, fields and moments. G. E. A.

451. A Theory of the Magnetic Properties of Iron and Other Metals. R. H. de Waard. *Phil. Mag.* 4. *pp.* 641–667, *Oct.*, 1927.

A discussion of the mechanism of the magnetisation of iron and ferromagnetic bodies in general, based on Barkhausen and van der Pol's experiments and abridged from the author's paper in Dutch (Utrecht Dissert., 1924). It is shown that with continuous change of H (the magnetic field), M (the magnetisation) is not only changing continuously, but also by small jumps. The paper demonstrates that the shape of a set of crystals which causes a jump must be extremely prolate and would be a long row of crystals forming a sort of chain in the direction of the external field. Specific cases are discussed, and in the case of crystal aggregates it is concluded that the more prolate the shape of the crystal complex, the sooner the complex will show a tendency to a simultaneous and concurrent jump of the magnetisations of the different parts. The constitution of the different chains with magnetic coherence largely depends on the aggregate structure. The general theory of ferromagnetism is given with simple illustrations—*e.g.*, homogeneous ellipsoids, etc.—and it is concluded that: (1) It is probable that the magnetic properties of bodies will essentially depend on the shape of these bodies; (2) there is no reason to believe that the behaviour of the magnetisation will merely depend on that of the internal field H. The application of the theory to steel, iron, nickel and cobalt is given. S. G. B.

452. Paramagnetic Double Refraction. A. Carrelli. *Accad. Lincei, Atti*, 5. *pp.* 684–688, *May* 1, 1927.

Refers to Ladenburg [see Abstract 612 (1926)]. Assumes the phenomena of paramagnetism to be due to the presence of non-compensated electronic orbits and a consequent magnetic moment in the atom or ion. The virtual oscillators which correspond to the variations of the stationary states of the rotating electrons are no longer equal in number for the two senses of rotation of the electrons with respect to the direction of the magnetic field after the creation of this has generated an orientation of the magnetic axes. This will give rise to a paramagnetic double refraction. The problem is worked out. A. D.

453. Magnetic Susceptibility of the Alkali Metals. J. C. McLennan, R. Ruedy and Elizabeth Cohen. *Roy. Soc., Proc.* 116. *pp.* 468–483, *Oct.* 1, 1927.

Solid sodium, potassium, rubidium and cæsium were tested by Plücker and Gouy's method, the metals being weighed with and without a strong uniform horizontal magnetic field; they were contained in vertical glass tubes, and were highly purified. All proved to be paramagnetic, including cæsium, which was found to be diamagnetic by Sucksmith and by Honda and Owen. Experiments were made with Na and Cs at the temperature of liquid air, and it was shown that the susceptibilities are constant from room temperature down to − 190° C. This is in disagreement with Pauli's formula, which predicts a change of paramagnetism with temperature. This independence of temperature is remarkable, as the metals are amorphous at ordinary temperatures, sodium is crystalline below 0° C., potassium below − 120° C., rubidium below − 35° C. and cæsium below − 80° C.; other properties show a change at these temperatures. H. N. A.

454. The Magnetic Susceptibilities of the Position Ions of Vanadium. S. Freed. *Am. Chem. Soc., J.* 49. *pp.* 2456–2468, *Oct.*, 1927.

The views of Lewis, Kemble, Sommerfeld and Hund are discussed, and it is pointed out that most of the work on magnetic susceptibility is vitiated by the magnetic impurities in the samples investigated. In this paper a new method is described for measuring magnetic susceptibilities; it is an adaptation of the Gouy method, which depends upon having a cylinder with one end in a uniform field and the other end in a field of negligible intensity. Measurements are given for the magnetic susceptibilities of the positive quadrivalent, trivalent and bivalent ions of vanadium, and the results seem to indicate that the quadrivalent vanadium ion has one, the trivalent ion has two, and the bivalent has three integral Bohr magnetons, these results apparently not agreeing with any current theory based upon the quantum theory and anomalous Zeeman effect. J. K.

455. Magnetic Susceptibilities of Vapours of Organic Liquids. V. I. Vaidyanathan. *Phys. Rev.* 30. *pp.* 512–515, *Oct.*, 1927.

The apparatus employed in this investigation consists essentially of a thin closed diamagnetic bulb suspended from one end of the beam of a modified Curie balance. The vapour under investigation surrounds this bulb. The complete balance is in an airtight chamber of suitable shape. The bulb moves horizontally and at right angles to a non-homogeneous field, causing a twist in the suspension fibre of the balance beam. The diamagnetism of the bulb is compensated as nearly as possible by enclosing the requisite quantity of air, so that at room-temperature there is very little magnetic force acting on it, if surrounded by a vacuum. Now if a diamagnetic vapour is introduced, the bulb apparently becomes paramagnetic, and is drawn towards the stronger part of the field, and *vice versa* if a paramagnetic vapour be introduced. Values relative to air were obtained in all cases. All the vapours examined were diamagnetic. The molecular susceptibilities determined for the vapour state were in many cases nearly equal to those calculated from the liquid state, but in some cases they appear to be higher. This is specially true in the case of CS_2 and C_6H_6, the molecules of which are known to possess a high degree of magnetic anisotropy in the liquid state. The results for these two substances await confirmation by independent investigations by other methods.

AUTHOR.

456. Determination of the Coefficient of Magnetisation of Certain Liquids. G. P. Arcay and M. Fallot. *Comptes Rendus*, 185. *pp.* 849–851, *Oct.* 24, 1927.

Employs the method of Sève, in which two communicating vessels are used, one of which is placed in a magnetic field, the resulting difference of level being measured. The authors have investigated collodion 28 per 1000, pure glycerine at 30° C., H_2SO_4, benzene, india-rubber in benzene, vaseline oil, castor oil and olive oil, all of which behaved normally. On the other hand, solutions of gelatine, gum arabic, albumen, gelose, casein and gelatinous silica show a creep in the level, which continues to descend slowly for a long time, in some cases for several hours. When the current is cut off the phenomenon is repeated in the opposite direction. It is regarded as being due to liquid rigidity.

H. N. A.

457. Photomagnetic Effect in AgCl and Se. C. W. Heaps. *J.O.S.A. and R.S.I.* 15. *pp.* 190–193, *Oct.*, 1927.

Garrison observed a change in magnetic susceptibility on the action of light on silver halides [see Abstract 1748 (1925)]. The author finds that, when radiometer action and radiation pressure are allowed for, there is no such effect in AgCl or Se. Free electrons therefore make no contribution to magnetic susceptibility. The diamagnetic susceptibility of Se must be due to electrons confined to the atom which take no part in electric conduction.

A. D.

458. Magnetic Disturbance and Aurora as observed by the Australasian Antarctic Expedition at Cape Denison in 1912 and 1913. C. Chree. *Phys. Soc., Proc.* 39. *pp.* 389–406; *Disc.*, 406–407, *Aug.*, 1927.

The paper summarises the results obtained as to the diurnal variation of magnetic disturbance during 1912 and 1913 at Cape Denison

(67° 0′ S. lat., 142° 40′ E. long.), the base station of the Australasian Antarctic Expedition. The results are compared with corresponding results from Eskdalemuir and Cape Evans, the base station of the British Antarctic Expedition. The paper also discusses the relations between magnetic disturbance and aurora at Cape Denison. AUTHOR.

459. Magnetic Storms. H. Deslandres. *Comptes Rendus,* 185. *pp.* 626–630, *Oct.* 3, 1927.

The analysis of the phenomena of magnetic storms brings out some singular results. The results are exactly as if the sun had a deep layer which turns like a solid and which presents twenty-four intermittent volcanoes equidistant from one another and discharging electrified particles, both negative and positive, which are separated into a spectrum, according to their velocities, by passage through a more superficial magnetic field. The discharges from these deep volcanoes can easily be made to explain sunspots, faculæ, magnetic polarities, etc., with all their peculiarities. The same discharges also readily explain the production of the more superficial magnetic field; and all is as if the volcanoes discharged particles from radioactive substances. The intermittent discharges may be from one of the deep volcanoes at a time, or several successive volcanoes may be in simultaneous activity. When all these are at rest the general surface-radiation of ultra-violet and X-rays, with some ions, accounts for the normal diurnal variation. **Errata** (*ibid.* p. 802, Oct. 17, 1927).

A. D.

460. Recurrent Phenomena in Terrestrial Magnetism. C. Chree and J. M. Stagg. *Roy. Soc., Phil. Trans.* 227. *pp.* 21–62, *Aug.* 3, 1927.

An exhaustive inquiry has been made to prove the existence of the 27-day interval, the observations being based on the years 1906–25. A primary pulse was obtained by use of the figures given for days specified by the international scheme having its headquarters at De Bilt, as "quiet" or "disturbed" days. The second, third and fourth secondary impulses were used in addition to the primary. It was found that the 27-day interval was present in disturbances of any size, large or small. No certain difference has been found in the length of the interval, 27·0 days, as between years of high and low sunspot latitude or years of many or few sunspots. There is an apparent tendency for the interval to be greater the larger the primary disturbance, but this is, at least, partly due to the tendency in a very large disturbance to rise more quickly than it falls. Reasons are given for the secondary pulse after large or small disturbance 27 days later. The secondary pulse is better developed in years of few than in years of many sunspots, and better in years of low than in years of high spot latitude, but other causes helping or hindering its development seem to exist. In some years there seems a decided tendency for the international "quiet" and "disturbed" days to form members of the same sequence. Supposing magnetic disturbance, due to radiation of some kind from the sun, and the solar area effective on any one day to be a narrow zone, then some solar zones must retain their disturbed conditions for many solar rotations, whilst others must be alternately much more disturbed than the average zone and much less. No trace has been found of the existence of any disturbance interval which is a submultiple of 27 days, as found by Deslandres, but there seems in all kinds of years a decided tendency for high disturbance to develop from 4 to 6 days after the occurrence of conspicuous quietness. R. S. R.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

461. Galvanic Polarisation and Nerve Excitation. P. Hoefer. *ZS. f. Phys.* 45. 3–4. *pp.* 261–284, 1927.

The validity of some theoretically deduced equations for galvanic polarisation by direct and alternating currents are proved, especially with reference to the theory of the electric excitation of living tissue. With direct current explanations were found for certain deviations which occurred, and when the causes of these were eliminated the theory was established. With alternating currents small deviations were found in the case of low frequencies. The elimination of these deviations lie outside the scope of the author's work. For higher frequencies the theory was confirmed. It was found, however, that with higher frequencies, through accompaniments of various kinds, a diminution of the polarisation can be reached, and, finally, the polarisation disappears completely. Thus an explanation can be given for the phenomenon that high-frequency alternating currents used with increasing frequency for the electric excitation of living tissue quickly become inactive, as should be the case according to Nernst's theory. J. J. S.

462. Calculation of the Heat Disengaged in the Tissues by High-Frequency Currents. C. Fabry. *Comptes Rendus,* 185. *pp.* 684–687, *Oct.* 10, 1927.

D'Arsonval [see Abstract 3213 (1927)] has shown that the heat developed in tissues by high-frequency currents is not alone due to the Joule effect, and has suggested that the additional heat is due to capacitative dielectric hysteresis. The present author shows mathematically that the effect is not due to such hysteresis, but is due to the effect of the milli-ammeter readings being the resultant of both a conductive and a capacitative current, the latter being wattless. B. J. L.

463. The Heating of Tissues by High-Frequency Currents. d'Arsonval. *Comptes Rendus,* 185. *pp.* 740–742, *Oct.* 17, 1927.

The author has previously shown [see Abstract 3213 (1927)] that heat produced by diathermy currents is not solely due to the Joule effect. Similar effects are noticed in the electrotherapeutic procedures, usually termed condensation, and the induction method, in which the patient is placed within a cage which conducts high-frequency currents. Experimental arrangements and conditions to approximate to the clinical conditions are enumerated, and as a result the author finds, as before, that the heat is not solely due to the Joule effect, as indicated by the ammeter readings. The author discusses the theoretical results of Fabry. [See preceding Abstract.] B. J. L.

464. The Theory of Nerve and Muscle Excitation by High-Frequency Currents of Short Duration. P. Lasareff. *Comptes Rendus,* 185. *pp.* 727–728, *Oct.* 10, 1927.

The conduction of electrical energy *via* nerve and muscle tissue between electrodes is considered as the conduction and deposition of salts at a semi-permeable membrane. The paper is purely mathematical, and various conditions as respects the current are considered. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

465. Gibbs on Adsorption. W. D. Bancroft. *J. Phys. Chem.* 31. *pp.* 1501–1506, *Oct.*, 1927.

From the work of Gibbs [Sci. Papers, 1. pp. 235 *et seq.*, 1906] it follows that the necessary and sufficient criterion for the applicability of the Freundlich equation to the case of the adsorption of a gas by a liquid in which the gas is practically insoluble is that the change of the surface tension is proportional to the change of adsorption. The exponent n in the Freundlich equation is a measure of the change of the surface tension with the adsorption in the case of a liquid adsorbent. It seems probable that the necessary and sufficient criterion for the applicability of the Freundlich equation to the case of the adsorption of a gas by a solid is that the change of the surface tension or of some equivalent property is proportional to the change of adsorption. T. H. P.

466. Foundations of the Static and Dynamic Displacement Theory. Part II. D. Reichinstein. *Z. El. Chem.* 33. *pp.* 455–469, *Oct.*, 1927.

An attempt is here made to amplify the considerations previously outlined into a consistent whole [Abstract 1135 (1926)]. To the adsorption law a double character, both static and dynamic, must be ascribed, since with processes of this kind a static-dynamic relativism in the sense of Einstein's equivalence law must be considered. The circumstance that, on the one hand, the static law of liquid solutions and, on the other hand, the dynamic model of the process of adsorption constructed on the classical liquid laws do not comprise the trans-mass of the solvent signifies that (1) the adsorption space has the property of a solvent in which not only the adsorbed substances, but also the solid adsorbent, play the part of solutes, and (2) dynamically the process of adsorption must be characterised as a slow-wetting or a slow-alloy formation. Thus the displacement principle not only represents the foundations on which both the statics and the dynamics of the adsorption process are constructed, but furnishes also a comprehensive description of solid solutions and liquid solutions. T. H. P.

467. Surface Area and Sorption. M. Tarlé. *Chem. Soc. Japan, Bull.* 2. *pp.* 243–245, *Sept.*, 1927.

The measurements of Sameshima [Abstract 1549 (1927)], which show that the amounts of carbon dioxide taken up by various samples of activated charcoal are independent of the area of the surface of the charcoal, are criticised, and his conclusion that the phenomenon of adsorption is due to solution of gas in the charcoal is not accepted. The density (2·1) of charcoal assumed by Sameshima in his calculations is too high, and, since carbon is highly porous, grinding does not appreciably increase the surface area. L. M. C.

468. Surface Area and Sorption. J. Sameshima. *Chem. Soc. Japan, Bull.* 2. *pp.* 246–249, *Sept.*, 1927.

The value assumed for the density of charcoal [see preceding Abstract] is supported by the measurements of Howard and Hulett [J. Phys. Chem.

28. p. 1088, 1924], and in any case does not seriously affect the author's argument. Evidence is produced to show that in the work previously described grinding increased the surface area of the charcoals in question by 6 %. The previous conclusion regarding the mechanism of the absorption of gas is defended. L. M. C.

469. Heat of Adsorption of Oxygen on Charcoal. Part II. W. E. Garner and D. McKie. *Chem. Soc., J. pp.* 2451–2457, *Oct.*, 1927.

The heat of adsorption of oxygen on charcoal varies with the amount of oxygen adsorbed per gramme of charcoal. A maximum value (70 cal.) was obtained when the number of gramme-molecules of oxygen adsorbed per gramme of charcoal was $1 \cdot 5 \times 10^{-5}$. The maximum heat of adsorption increases rapidly with increase in temperature, approaching 115 cal. between 100° and 200°. It rises again from 200° to 450°. The results are discussed in regard to the chemical constitution of the C_xO_y complex. A. B. W.

470. Boundary Surface Activity (Adsorbtivity) and Dielectric Constant. P. Rehbinder. *Zeits. phys. Chem.* 129. *pp.* 161–175, *Oct.*, 1927.

This paper investigates the dependence of the boundary surface activity and the adsorption at several separation surfaces on the polarity, as, for example, the dielectric constant of both the boundary surfaces forming the phases and of the adsorbed substances. The experimental results show that the polarity difference of two adjacent phases can be determined by the difference in dielectric constant of the two phases or from the free surface energy at the separation surfaces in their pure state. The experimental results show that the boundary surface activity (that is, the adsorbtivity) for a given active substance partitioned between two phases continuously increases with increase of polarity difference, with the increase of the surface energy in the pure state, as well as with the increase in the dielectric constant difference. For an increase in the polarity difference of two adjacent phases the adsorption properties of their common separating surface increases also in a continuous manner for a given active material. Reference is also made to the "compensation rule," which states that with the mutual adsorption of an adsorbed material the polarity and the dielectric constant of the two adjacent phases tend to equalise in the separating layer, which rule is shown to explain several contradictions. J. K.

471. On the General Theory of Absorption and Partition Phenomena. W. Sementschenko. *Zeits. phys. Chem.* 129. *pp.* 176–185, *Oct.*, 1927.

Upon the foundation of the Boltzmann *e* law formulæ for the adsorption and the solubility of gases are obtained. These formulæ show that the absorption, heat of absorption and the solubility of the gases are parallel to the values of the moments of the molecules. It is also shown on the basis of this law that the concentration of the solute is less in the upper layer than within the solution when the molecules of the solute possess greater moments than that of the solvent, and *vice versa*. Many formulæ are deduced. On the whole this paper is mathematical and does not lend itself to abstraction. J. K.

472. Heats of Solution and of Dilution. Part III. Potassium Fluoride and its Dihydrate. E. Lange and A. Eichler. *Zeits. phys. Chem.* 129. *pp.* 285–300, *Oct.*, 1927.

The paper explains the preparation of the anhydrous KF, by heating $KF\,.\,HF$ in a current of dry nitrogen, and of the dihydrate $KF\,.\,2H_2O$, which was crystallised from hot water and was also studied in saturated solution. Aqueous solutions of KF of medium concentration do not attack glass. The heat of hydration $KF \rightarrow KF\,.\,2H_2O$ is $+ 5912$ cal. per mol. KF; the first heat of solution of the anhydride is $+ 4244$ cal., that of the hydrate $- 1668$ cal. per mol. As regards the heat of solution, KF differs from other potassium halides in sign and also in the trend of the curves, except at high dilution. KF resembles in these respects LiCl and LiBr. The experiments are made at 25° C., at which temperature the saturated solution contains 30·49 mol. KF per 100 mol. H_2O. [See Abstract 2717 (1926).] H. B.

473. Mutual Relations between Dissolved Gases and Solvents at Different Temperatures. G. Tammann. *Z. El. Chem.* 33. *pp.* 425–428, *Oct.*, 1927. *Paper read before the Deut. Bunsen Gessell., Dresden, May,* 1927.

When gases are dissolved the gas concentration may be greater or smaller in the saturated solution than in the gas space above. In the former case the solubility of the gas decreases, in the latter case it increases, as the temperature is raised. When H_2, N_2, and CO are dissolved in alcohols, acetone, benzene, aniline, chloroform, carbon disulphide, etc., the solubility is found to be such that $d \log l\,.\,10^5/\log l\,.\,dT$ has approximately a value corresponding to $1/T = 339\cdot10^{-5}$. That CO_2 behaves differently indicates that this gas forms new molecules with the solvent. In water the solubility curves show a minimum at certain temperatures, mostly above 40° C., after which the solubility increases again very slowly. The high solubility of gases (except helium and neon) in moderately warm water is ascribed to the affinity of the gases for the molecules of ice I [see Abstract 287 (1914)], and is proportional to the concentration of this ice, with which most gases seem to form hydrates, though these hydrates have not yet been isolated. In the case of the rare gases argon, krypton and xenon such hydrates have been obtained by Villard and by Forcrand; the latter assumes that helium and neon should likewise form hydrates at pressures of thousands of atmospheres, but that seems improbable when the solubility curves of Antropoff are accepted. H. B.

474. Dangers from Static Electricity in Handling Solvents. A. A. Backhaus. *Chem. and Met. Eng.* 34. *pp.* 620–621, *Oct.*, 1927.

Little danger of the development of static electricity attends the flow of conducting solvents through pipe lines. If the liquid has a low conductivity the pipe lines should be good conductors and well earthed. In dry-cleaning plants addition of 0·05 % of magnesium oleate to the gasoline is recommended, and under certain conditions the presence of powdered metal will render gasoline non-electric. The discharge of an inflammable liquid from a pipe should be at the bottom of the receiving tank, so that spray may not be formed. When this is not possible, the charges generated on the droplets may be rendered innocuous by moistening the air or by ionising it by the action of ultra-violet light or X-rays. Danger attends the use of gaseous solvents or of hydrogen under certain conditions, owing to the development of a static charge. T. H. P.

475. Passivity of Iron Mirrors. Part II. H. Freundlich, G. Patscheke and H. Zocher. *Zeits. phys. Chem.* 130. *pp.* 289–307, *Oct.*, 1927.

The authors give further particulars about the preparation of the iron mirrors [see Abstract 211 (1928)] and describe the optical tests. When polarised light falls upon metals, the phase-displacement and the amplitude-decrease are not the same for the two components, vibrating in the plane of incidence and at right angles to that plane; the reflected light is elliptically polarised and the plane rotated. The angle of incidence was in the experiments generally 60°. The changes mentioned were for the iron mirrors more or less smaller than for massive iron, according as the mirrors were more or less transparent. The phase-displacement was instantaneously diminished, and the amplitude-ratio enlarged, on contact of the mirror with air; evacuation to pressure of 10^{-4} mm. did not restore the initial condition. The changes produced by mere contact with the air, excluding possible changes of the surface structure by chemicals, are ascribed to the same oxide films which cause passivity (Haber and Goldschmidt). The film thickness would, on Drude's theory, be about 1 $\mu\mu$. H. B.

476. Electrical Ionic Field and Salting-Out. P. Debye. *Zeits. phys. Chem.* 130. *pp.* 56–64, *Oct.*, 1927.

The effect of ions on the solubility of non-electrolytes is discussed from the standpoint of the strong electrical field which surrounds the ions. The paper is a mathematical development of the behaviour of solutions of non-electrolytes to which solutions of electrolytes have been added. The paper does not lend itself to abstracting. F. J. B.

477. Stability of Suspensions. Part II. Rate of Sedimentation of Kaolin Suspensions containing Colloidal Silicic Acid. W. O. Kermack and W. T. H. Williamson. *Roy. Soc. Edinburgh, Proc.* 47. 2. *pp.* 202–221, 1926–1927.

The experiments on the effect of salts at various hydrogen-ion concentrations on the rate of sedimentation of kaolin suspensions [Abstract 1760 (1925)] are extended to include the chlorides of the alkali metals, including ammonium but excepting rubidium. In acid suspensions the action in inhibiting sedimentation is least with cæsium and greatest with sodium. When kaolin suspensions contain a small quantity of colloidal silicic acid, the normal effect appears to be one of slight protection, but under certain conditions the effect of silicic acid is to produce precipitation of a film of insoluble material over the surface of the particles. In such case an abnormally rapid sedimentation of the particles results and an extremely rapid and complete precipitation ensues. Under other conditions the presence of the silicic acid prevents the formation of a precipitate, and the abnormal sedimentation occurring in the absence of silicic acid then tends to disappear. T. H. P.

478. The System Phenol-Water. E. R. Jones. *J. Phys. Chem.* 31. *pp.* 1316–1321, *Sept.*, 1927.

The phase diagram has been established for the system phenol-water below 13° C. The existence of two eutectic points, phenol hydrate, solution, ice (at − 0·843° C. and 4·607 gm. of phenol/100 gm.) and phenol, solution and ice (at − 1·174° C. and 6·839 gm. of phenol/100 gm.)

noted, whilst the existence of an unstable invariant point (ice and two liquid phases) is indicated at — 1·252° C. Solubility measurements have also been made. The freezing point of pure phenol is given as 40·71° C.

L. M. C.

479. Structure of Cubic Crystals of Metals after Compression and Tensile Tests. F. Wever. *Zeitschr. f. tech. Phys.* 8. 10. *pp.* 404–407, 1927.

Metals stretched in cold work assume a structure such that the plane of closest packing becomes normal to the direction of tensile stress, and that other planes arrange themselves symmetrically to that direction, the resistance to shear having, according to Körber [Abstract 2045 (1922)], its maximum in the plane of closest packing; any rotation will decrease the resistance to shear in at least one plane. But the effects of tensile traction and of cold rolling could so far not be explained on quite the same lines. The gap promises to be filled up by the study of the uniform compression obtained by Siebel [see next Abstract]. The author cuts rods of 2 mm. diameter axially from cylinders of copper and iron, compressed by 80 %, and examines them by the Debye-Scherrer method with the aid of polar radiograms. The chief direction to be considered is the direction of flow. In compression this flow is in a plane at right angles to the stress, and the change in the structure occurs in the sense that as many other planes as possible (three in the case of face-centred crystals) assume that position.

H. B.

480. Compression Tests of Metals. E. Siebel. *Zeitschr. f. tech. Phys.* 8. 10. *pp.* 401–404, 1927.

Compression tests are not much in use because unequal stress distribution is difficult to avoid, even between plane-parallel plates lubricated with oil and graphite (Hübers in 1922). Compression betweeen conical surfaces was tried by Riedel in 1913, but the specimens were not appropriately prepared, and his cones (base angle $\alpha = 45°$) were too steep. The author uses for soft steel cones of $\alpha = 14°$ and for hard steel cones of $\alpha = 8°$. The ratio of height to diameter in cylindrical specimens should not be less than 1. With his machine (briefly described) a uniform stress distribution is obtained. The specimen does not bulge out in barrel fashion, but remains cylindrical when compressed by 12·5, 25, 50 %. The slag enclosures, arranged in parallel lines in the original specimen, retain their parallelity, and recrystallisation tests of the compressed specimen show a uniform grain texture throughout. The most difficult part of the test is to secure uniform contact between the plates and the piece.

H. B.

481. Structure of Rolled Metals of the Cubic Face-Centred Crystal Type. F. Wever and Winfried Schmidt. *Zeitschr. f. tech. Phys.* 8. 10. *pp.* 398–400, 1927.

While Polányi, and Mark and Weissenberg [see Abstract 1869 (1923)] aimed at giving a picture of the final ideal position of the crystallites in rolled metals, one of the authors [see Abstract 439 (1925)] wished in the first instance to obtain complete polar radiograms of the chief planes. The method has been supported by Göler and Sachs and by W. H. Bragg. The present paper illustrates a series of Debye-Scherrer radiograms and the deduced polar diagrams of aluminium foil, rolled down in five steps from a thickness of 0·6 mm. to 0·01 mm., finally by 98 %. Similar experiments were made with copper and silver foil. The photometric examination was easiest for a ray direction at 20° to the direction of rolling. It is concluded that the former polar diagram of the rolled metals of the cubic face-centred crystal type represented intermediate conditions of incomplete rolling, and that the final predominating positions depend upon the type of mill and the method of rolling. H. B.

482. Mechanism of Certain Chemical Light Reactions. V. Kondratjew. *ZS. f. Phys.* 45. 1–2. *pp.* 67–82, 1927.

The reaction between potassium and mercuric chloride proceeds in two ways, the one reaction taking place in the free gas space, and the other requiring the presence of a solid body; these two reactions occur independently of each other. The spectrum of the luminescence appearing in the gaseous space contains only the lines of the alkali metal, whereas that of the surface reaction belongs presumably to the mercuric chloride. In the case of the space reaction, the distribution of the light distribution in the zone of the reaction, as calculated on theoretical bases, is verified by photometric investigation, various conclusions relating to the velocity of reaction being indicated thereby. The reactions between potassium or sodium and mercuric bromide, mercuric iodide, or cadmium chloride, proceed similarly to that between potassium and mercuric chloride.

T. H. P.

483. The Chemistry of Coal. R. V. Wheeler. *Engineering*, 124. *pp.* 344–346, *Sept.* 9, 1927. *Paper read before the British Assoc., Leeds, Sept.*, 1927.

A review of the results of investigations initiated in 1916 on the nature of coal. Coal is chemically divisible into two main groups of constituents; one composed of the resistant plant materials in a modified form, such as spore exines, cuticular tissues and resins, and the other the coal ulmins derived from cellulose tissues and cell contents. Ulmins in coal are rendered soluble in alkalies by mild oxidation (by substitution of carboxyllic groups for readily oxidisable radicals attached to the ulmin molecules), whilst further oxidation with nitric acid causes their breakdown into products which suggest that the parent bodies are composed of hexacyclic aromatic rings linked together by furane structures in which oxygen may be replaced by nitrogen or sulphur. On distillation at low temperatures the ulmins yield chiefly water with some phenolic tar, and at higher temperatures oxides of carbon and hydrogen are also evolved. Increase in age of the coals from which the ulmins are derived determines the relative proportion of the products of distillation, carbondioxide and water decreasing with increasing age. The resistant plant remains yield on distillation a high percentage of liquid hydrocarbons and a little gas. It is possible to correlate the behaviour of coal under varying conditions, with the presence of one or other of the major constituents, *e.g.*, in those reactions of coal which involve oxidation, the ulmins play the chief part, whereas the resistant plant remains are the chief factor in its behaviour on distillation. The solvent action of pyridene and chloroform on the various coal constituents is discussed. The constitution of a coal is shown to depend largely on the changes brought about by pressure, temperature and time on the ulmins it contains. L. M. C.

484. The Notion of Complete Heterogeneous Equilibrium. R. Wegscheider. *Zeits. phys. Chem.* 130. *pp.* 44–48, *Oct.*, 1927.

Systems which allow of transformations at constant temperature without alteration of the pressure and concentration include invariant and univariant systems and also systems with more degrees of freedom at singular temperatures, for which a smaller number of components suffices to represent the compositions of all the phases than for other temperatures. Among these systems are those in which the equilibrium is disturbed by changes of volume. The notion, " complete heterogeneous equilibrium," which was not exactly defined by Roozeboom, is superfluous, but, if used, should be employed synonymously with univariant systems and not to designate systems which support alterations in the volume without displacement of the equilibrium. T. H. P.

485. Laboratory Study of Nitrogen Fixation by the High-Tension Arc. P. G. Colin and H. V. Tartar. *J. Phys. Chem.* 31. *pp.* 1539–1558, *Oct.*, 1927.

The authors refer to a previous work from the University of Washington Laboratory [see Abstract 2744 (1926)] and discuss briefly the literature having a direct relation on the experimental results presented dealing with (1) the effect of reduced pressure on the yield of fixed nitrogen with a constant velocity of the molecules of gas through the arc, and (2) equilibria obtained in an arc with variation of conditions, such as pressure and composition of the initial gas. The question whether the reaction between nitrogen and oxygen in the high-tension electric arc is a typical reversible reaction obeying the law of mass action is carefully considered from an experimental point of view, when it is shown that the law approximately holds for this reaction at pressures greater than one-half atmosphere. The work and views of many other experimenters are compared, and it is shown that water cooling of the gases after leaving the arc is unnecessary. Reduced pressure gives a decrease both in the concentration of nitric oxide and in the yield of fixed nitrogen per kilowatt-hour; the maximum equilibrium concentration of nitric oxide over a wide range in pressure is dependent upon the current; variations in the velocity of the gases produce little marked effect on this equilibrium concentration; whilst the concentration of nitric oxide may become high in an uncooled high-tension electric arc at reduced pressure. J. K.

486. Studies in Photosensitisation. Part I. J. R. Bates and H. S. Taylor. *Am. Chem. Soc., J.* 49. *pp.* 2438–2456, *Oct.*, 1927.

The work of Sherrill, Olson and Meyers, and Senftleben is reviewed, and the object of this paper is an attempt to broaden the field still further by the introduction of improvements in the light sources, such as a new type of cooled mercury arc, for use in the study of a number of photosensitised processes and general photochemical reactions. It is shown that an increase of energy input into a high-pressure hydrogen discharge a continuous ultra-violet spectrum to 1900 Å. can be obtained and recorded with short exposure; that ethylene condenses under the influence of excited mercury atoms with an initial rise in pressure, this being discussed; that acetylene is polymerised by both excited mercury atoms and by ultra-violet light, and that under certain conditions hydrogen peroxide can be obtained as the sole product from a mercury photosensitised reaction between hydrogen and oxygen. The mechanism of other photochemical decompositions is also investigated. J. K.

487. Effect of the Acidity of the Support on the Structure of Monomolecular Films. H. Egnér and G. Hägg. *Phil. Mag.* **4.** *pp.* 667–670, *May*, 1927.

Adam found that a film of palmitic acid occupied a larger area per molecule when the *p*H of the supporting water was less than 5·5 than when it was higher. The critical acidity is almost the same for all fatty acids. The relation between *p*H and the degree of dissociation of an acid is governed by the equation $\alpha/(1-\alpha) = 10^{pH - pK_\alpha}$, where $pK\alpha$ is the negative logarithm of the dissociation constant, it follows that the transformation from the undissociated to the dissociated form is most rapid when $pH = pK\alpha$. A table shows that the values of $pK\alpha$ for the lower acids, from formic to nonylic, with the exception of formic acid, only vary from 4·73 to 4·96, while for the higher acids it is quite near 5·0, which is about the value of *p*H at which the change in area takes place. It is suggested that dissociation phenomena are the cause of the change. If this is correct, it may furnish a means of determining the dissociation constants of sparingly soluble substances. H. N. A.

488. Union of Helium with Mercury. J. J. Manley. *Phil. Mag.* **4.** *pp.* 699–720, *Oct.*, 1927.

In the simplest form of apparatus employed a barometer tube containing some pure helium was oscillated for a long period, and it was found that the pressure of the helium was reduced. An apparatus was then constructed in which the mercury helide formed was condensed in a capillary U-tube surrounded with liquid air, which communicated with the barometer tube through a bulb packed with gold-leaf to prevent mercury vapour from passing into the capillary. The other end of the capillary communicated with a spectrum tube, which showed the mercury green line; the intensity of this increased when the liquid air was removed. This mercury must have passed into the spectrum tube as mercury helide. Attempts were made to obtain a quantitative analysis of the helide. In these synthetisers were employed, in which high-tension discharges were passed through the helium and mercury vapour. In one of these attempts the composition $HgHe_{10}$ was arrived at, while the other corresponded to HgHe, or more probably $HgHe_2$. For particulars of the methods used the original paper should be consulted. H. N. A.

489. Influence of a Second Substance on the Osmotic Pressure. P. A. H. Schreinemakers. *Zeits. phys. Chem.* 130. *pp.* 120–124, *Oct.*, 1927.

In this entirely mathematical paper it is found that the change of osmotic pressure produced by the introduction of a second substance into a system is dependent on its concentration on both sides of the membrane; also that when these concentrations are equal a change in the osmotic pressure is produced. Quantitative expressions for the changes are derived in the paper. H. H. Ho.

490. The Products formed during the Action of the Lead Accumulator. L. Mazza. *Accad. Lincei, Atti,* **5.** *pp.* 688–693, *May* 1, 1927.

In previous papers the author has dealt with the subject of the substances formed upon the charge and discharge of the lead accumulator, giving the experimental results of the examination of the positive plate.

As regards the negative the enquiry is interesting not only from the decision as to the normal products got when the accumulator functions, but also from finding out whether the spongy lead which forms the negative plate is an allotropic form of lead in the ordinary sense of the word. Observations were made by means of X-rays, and it was established that the spongy lead which forms the active material of the negative plate of the lead accumulator has a crystalline structure which does not differ in the shape or dimensions of the lattice from that of ordinary lead. The theory of Gladstone and Tribe receives notable confirmation from the experiments, whilst other chemical theories are totally or partially invalidated. The active substance which constitutes the positive electrode is composed of PbO_2, identical in its crystalline structure with PbO_2 obtained by chemical methods. The almost black colour shown by the positive plate is due to the larger dimensions of the crystalline particles of PbO_2. In the discharge of the accumulator a product is formed which may be identified by its crystalline structure with $PbSO_4$, in a subdivided state (probably of colloidal dimensions) and mixed with notable quantities of PbO_2 or Pb. J. J. S.

491. Local Action in the Voltaic Cell. M. Centnerszwer and M. Straumanis. *Zeits. phys. Chem.* 128. 5–6. *pp.* 369–393, *Sept.*, 1927.

After stating the present position of the theory of local action the authors describe an arrangement for the simultaneous measurement of the potential of the electrodes, the current strength and the internal resistance of the model of a local element. From the observations made they conclude that: (1) The logarithm of the current strength decreases, with constant potential of the anode, proportionally to the time. (2) This relation may be deduced as a consequence of Bogaski's law. (3) The potential of a metal in acid is in consequence of its anodic solution positive; with rise of the external resistance of the cell the potential of the anode is negative, with rise of the internal resistance of the cell positive. (4) In general the potential of the anode is positive with increasing current strength and tends to a limiting value, which varies in different electrolytes. (5) The constant of the rate of solution of an anode in different acids (or in one acid with varying concentration) is under ordinary circumstances the greater the greater the equivalent conductivity of the acid. (6) The logarithm of the current strength increases in the local element proportionally to the temperature. When the element is short-circuited $\frac{d \log i}{dv} = c$, where $c =$ temperature coefficient of the specific conductivity. (7) The rate of stirring plays a subordinate part in the anodic solution of zinc. (8) The anodic rate of solution of a metal is the greater the smaller is the "over-tension" at the kathode. (9) The anodic behaviour of cadmium, iron and tin is in general similar to the behaviour of zinc. J. J. S.

492. Measurement of the Polarisation Capacity of Platinum Plates in Sulphuric Acid. W. T. Heys. *Journ. Sci. Instruments*, 4. *pp.* 401–409, *Oct.*, 1927.

The paper describes a method of determining the polarisation capacity of an electrolytic cell consisting of platinum electrodes in sulphuric acid. Across the cell is placed a condenser of known capacity, and the system is short-circuited. The short circuit is broken and a second condenser of known capacity is charged to a known potential and then discharged into the system. The first condenser is disconnected from the electrolytic cell and from the second condenser and then discharged through a ballistic galvanometer. Hence the potential difference attained by the electrolytic cell, which is the same as that of the first condenser, is calculated. It is impracticable to determine the potential difference from a discharge of the second condenser, because of the residual effects. The depolarisation of the cell is rapid and the potential difference immediately after discharge of the second condenser into the system is deduced by varying discontinuously the time of contact of the cell with the first condenser. The various connections and disconnections are made by means of a falling vulcanite plate on which are specially shaped brass plates, which, during the fall of the plate, pass over suitably placed connecting brushes. That the results obtained mean something definite and are substantially accurate is proved by the determination of certain polarisation capacities by (1) a bridge method, using alternating currents provided by triode valves, and (2) the falling plate method. The values obtained by the two methods are in substantial agreement. AUTHOR.

493. Determination of the Hydration of Ions. G. Baborovský. *Zeits. phys. Chem.* 129. *pp.* 129–160, *Oct.*, 1927.

A modification of the method of Remy [see Abstract 2645 (1927)] who had fixed the middle portion of the electrolyte by the aid of gelatine in order to be able to determine the concentration changes at the two electrodes. The author uses diaphragms of parchment paper. His two cells are either simple glass tubes connected by a U-tube fitted with two diaphragms, or two U-tubes connected by a short tube fitted with only one diaphragm; the latter arrangement is preferable for long-continued work. The electrodes are spiral silver wires; the kathode is coated with AgCl; the anode is first coated in the same way, and the coating then electrolytically reduced. The silver wires are reweighed before and after a test. The true transference number (1 − N) and the electrolytic transference of water are determined for solutions of the chlorides of Na, K, Li, and also for HCl, in concentrations from normal 1 N down to 0·1 N; the bromides of the three metals are further studied in normal solutions. The electro-osmotic effect being, according to Remy, negligible in the halide solutions, the author calculates that the ions are, in hydration, taking up the following numbers of molecules H_2O: $H^{\cdot}$ 2, $K^{\cdot}$ 5, $Na^{\cdot}$ 8 to 9, Li' 13 to 14, Cl' 4, Br' 3. These values differ much from those which Bjerrum and Schreiner deduced in 1920 from activity measurements ($H^{\cdot}$ 10 molecules of water). Explanations for the discrepancy are suggested. H. B.

494. Potential of a Proposed Standard Form of Copper and Activity of Copper Sulphate. R. F. Nielsen and D. J. Brown. *Am. Chem. Soc., J.* 49. *pp.* 2423–2426, *Oct.*, 1927.

The spongy copper prepared by Lewis and Lacey's method of electrolysing copper sulphate rapidly on a platinum point [Abstract 1936 (1914)] fails to yield reproducible results as a standard form of copper for use in potential measurements, and invariably loses its reducing activity slowly when kept under concentrated copper sulphate solution. Satisfactory results are, however, furnished by a two-phase electrolytic amalgam prepared by electrolysis of a half-molal copper sulphate solution, slightly acidified, using a current density of about 5 amperes per sq. dm. of mercury surface and a copper anode; the amalgam is kept under the solution after preparation. The potential of this amalgam is $-0 \cdot 3502$ volt, and is independent of the relative quantities of copper and mercury within fairly wide limits. T. H. P.

495. Thermodynamic Evaluation of the Contact Potential of Two Fused Salts in Certain Cases. R. Lorenz. *Zeits. phys. Chem.* 130. *pp.* 39–43, *Oct.*, 1927.

Experimental results show that the e.m.f. of the fused Daniell cell, *e.g.*, $Cd|CdCl_2|PbCl_2|Pb$ is approximately equal to the difference between the values of the e.m.f. for the two salt-forming cells, $Cd|CdCl_2|Cl_2$ and $Pb|PbCl_2|Cl_2$. This rule, which should hold almost without exception, has been verified in a number of instances. From this it follows that the potential at the contact between two fused salts, such as $CdCl_2$ and $PbCl_2$, is given by $\pi = \pi_2 - \pi_3$, where π_2 is the potential between fused $CdCl_2$ and Cl_2 and π_3 that between $PbCl_2$ and Cl_2. Calculation shows that π is given by the expression $\frac{n\mu(Cl')_2 - n\mu(Cl')_1}{rF}$, where n indicates the valency of the metals of the salts, and $\mu(Cl')_2$ and $\mu(Cl')_1$ the thermodynamic potentials of the chlorine ions in the two salts, and r and F have their usual significance. T. H. P.

496. Colloidal Palladium as a Catalyser in the Hydrogen Electrode. E. Billmann and A. Klit. *Zeits. phys. Chem.* 130. *pp.* 566–571, *Oct.*, 1927.

The results are given of experiments on hydrogen electrodes in which the transformation of hydrogen into hydrogen ions and *vice versa* is catalysed by colloidal palladium in various concentrations. With bright platinum electrodes potentials are reached which agree exactly with those obtained with ordinary platinum electrodes coated with platinum black. With gold electrodes the agreement is less close, but still moderately good. The polarisability of the electrodes depends on the concentration of the palladium, 2 milligrams per litre of the colloidal metal resulting in definite potentials. T. H. P.

497. Differential Electrometric Titration as a Precision Method. D. A. MacInnes. *Zeits. phys. Chem.* 130. *pp.* 217–221, *Oct.*, 1927. *In English.*

The author refers to an earlier paper by MacInnes and Jones [see Abstract 1217 (1927)] wherein is described a potentiometric titration method by means of which the tangent curve to the usual titration curve is obtained directly, the end of the titration being a sharp definite maximum instead of the usual point of inflection. The limit of accuracy of this method is now tested, and it is shown to give the end points in titrations with great accuracy. The results are given for the titration, using the differential electrodes, of $0 \cdot 1$ N . As_2O_3 with approximately $0 \cdot 1$ N . iodine solution, as well as the titration of $0 \cdot 1$ N . oxalic acid solution with approximately $0 \cdot 1$ N . potassium permanganate. The titrations of hydrochloric acid with sodium hydroxide in the presence of phenolphthalein are said to give results of the same order of accuracy. The titration of a ferrous salt with permanganate or dichromate does not lead to the obtaining of consistent results. The authors are going to repeat these titrations in the presence of an inert gas. It is also shown that by the use of the differential electrodes method, as, for example, the titration curve obtained for the reaction of a base with an acid in the presence of quinhydrone, two maxima are obtained, indicating two points of inflection in the curve obtained by the usual method. This method thus prevents errors likely to be obtained by the ordinary method. J. K.

498. On the Thermodynamical Difference in Potential at the Boundary of Two Liquid Phases. S. Wosnessensky and K. Astachow. *Zeits. phys. Chem.* 128. 5–6. *pp.* 362–368, *Sept.*, 1927.

Reference is made to an earlier paper by these authors [see Abstract 2233 (1926)], in which was indicated the impossibility of determining practically the difference in potential at the boundary of two immissible liquid phases. The conclusion concerning such an impossibility was arrived at because it was not considered feasible to make a chain containing only one unknown potential difference. However, according to the results of Wild on electrocapillary curves in non-aqueous solutions an indirect conclusion is arrived at that by the partition of KCl between two liquid phases the difference of potential at a boundary must be near zero and can never be higher than 5 to 7 millivolts. This being the case, that is, if the difference may be taken as zero, it is then possible to build up a heterogeneous chain, that one phase pair consists of KCl, the other containing the electrolyte to be determined; in this case the chain having only one unknown difference in potential. A direct experimental verification of this conclusion has not so far been obtained. Further, a large percentage difference is obtained according as to whether the value zero or 5 millivolts is given to the potential difference at the boundary "KCl in water|KCl in non-aqueous phase." In this paper is described how to build up practically the required chain, the practical difficulties being indicated and overcome. An example of a chain investigated is :—

$$\text{N-Electrode}\;\Bigg|\;\begin{matrix}n\text{KCl}\\ \text{in}\\ \text{water}\end{matrix}\;\rightleftarrows\!\Bigg|\;\begin{matrix}x\text{KCl}\\ \text{in}\\ \\ \end{matrix}\;\Bigg|\;\begin{matrix}\text{Amyl}\\ \text{alcohol}\\ \text{saturated}\\ \text{with HCl}\end{matrix}\;\Bigg|\;\begin{matrix}\text{Electrolyte}\\ \text{A}\\ \\ \end{matrix}\;\rightleftarrows\!\Bigg|\;\begin{matrix}\text{A}\\ \text{in}\\ \text{water}\end{matrix}\;\Bigg|\;\begin{matrix}\text{Saturated}\\ \text{KCl}\\ \text{in}\\ \text{water}\end{matrix}\;\Bigg|\;\text{N-Electrode}$$

The conclusions arrived at are that, where the electrolytes to be partitioned are not too concentrated, the potential difference at the boundary of the phases remains constant as long as the partition coefficients of these electrolytes remain constant; at higher concentrations, however (more than 0·5 normal), the potential difference reaches a definite value, and remains constant, even if the partition coefficient varies; according to the magnitude of the charge given to the phases, the kations and anions are partitioned in a definite sequence, it being noticed that the kations are partitioned according to their degree of hydration and also in spite of not having definite data concerning the degree of hydration of anions, nevertheless it appears as if, according to the data obtained, that the anions arrange themselves in sequence according to their degree of hydration also. J. K.

499. Activity Coefficients of Electrolytes. Part I. Bivalent Salt and the Ion Attraction Theory. U. B. Bray. *Am. Chem. Soc., J.* 49. *pp.* 2372–2380, *Oct.*, 1927.

To test the ion attraction theory [see Abstract 2169 (1924)] beyond previous limits tests were made on electrolytes of high valency, the activity coefficients of the bi-bivalent salt ZnSO$_4$ being determined through e.m.f. measurements. These were made on the cell Zn-Hg (2-phase) | ZnSO$_4$ | PbSO$_4$ | Pb-Hg (2-phase) over the range of concentrations 0·0006 to 3·4 M. Particulars are given of the preparation of the materials and of the experimental method. When the ionic activities are 1 M the potential of the cell is found to be 0·41302 volts. The mean activity coefficients for Zn^{++} and SO$_4^{--}$ have been calculated for this range from theory using Kockel's value of 0·514 for A. The experiments lead to a value of 0·523 for A. At concentrations above 0·005 M the deviations of the observed and calculated values of the activities increase extraordinarily rapidly, showing that in the case of ions of higher valency the theoretical equation must have substantial corrections applied to it, besides that of taking into account the size of the ions. R. S. R.

500. Absorption and Diffusion of Hydrogen developed Electrolytically by Metals in Relation to Electrolytes. A. Coehn and H. Baumgarten. *Zeits. phys. Chem.* 130. *pp.* 545–565, *Oct.*, 1927.

The electric charge which is usually carried by gas bubbles in solution and by which hydrogen bubbles generated electrolytically either adhere to the kathode or are torn from it, is found to be of prime importance for the absorption and diffusion of the hydrogen by palladium, palladium-silver alloys, and iron. The presence or lack of relationship of the absorption and diffusion towards the nature and concentration of the solution from which the hydrogen is evolved decides if the hydrogen is taken up by the kathode metal only in its liberated state or also in the gaseous phase. Contrary to what happens with the above metals and with tantalum, in the case of platinum loading with the gas bubbles has no influence on the diffusion, so that at the ordinary temperature gaseous hydrogen is not taken up by platinum. T. H. P.

501. Theory of Metallic Corrosion in the Light of Quantitative Measurements. G. D. Bengough, J. M. Stuart and A. R. Lee. *Roy. Soc., Proc.* 116. *pp.* 425–467, *Oct.* 1, 1927.

Consideration of the modern theory of corrosion of metals, by which is meant chemical or electrochemical oxidation, indicates that the process should be influenced by the temperature, the presence of gaseous oxygen, the hydrion concentration, the amount and distribution of the oxygen supply, the nature and distribution of the products of corrosion, the conductivity of the liquid, and the metal ion concentration, as well as by factors appertaining to the metal itself. A new oxygen absorption method of measuring corrosion, allowing of the control of the above factors, is described, and the results given of its application to zinc. For specimens of annealed zinc in 0·0001 and 0·0002 N potassium chloride solutions, the corrosion curve has three branches: (1) This corresponds with an increase in the rate of corrosion, at first slow but later more rapid. The initial corrosion depends probably on slight differences of oxygen distribution, these being increased by such factors as the formation of screens of corrosion products round the initial centres of corrosion until a maximum is reached, when oxygen is nearly excluded from the corroded areas. (2) The second branch corresponds with the equation, $y = \mathrm{A}(1 - e^{-kt})$, in which y is the oxygen absorbed in time t and A and k are constants. (3) Here the corrosion falls away very considerably from that calculated according to the above equation, owing mainly to the barring out of some of the chlorine ions from the anodic areas by means of accumulation of corrosion products, and possibly also to the narrowing of the corrosion pits as they deepen. T. H. P.

502. Electrolytically Deposited Cadmium as a Protection for Metals and Alloys against Corrosion. J. Cournot and J. Bary.

Comptes Rendus, 185. *pp*. 773–774, *Oct*. 17, 1927.

The use of electrolytically deposited cadmium as a protection against corrosion was described in a previous paper [see Abstract 1227 (1927)]. The deposits of cadmium were compared with deposits of nickel, and with deposits of nickel on copper, and nickel deposited on cadmium. It was found that mild steel test pieces coated with cadmium nickel withstood the action of boiling salt water for nineteen hours before rust appeared, while the copper-nickel coating showed rust spots after seven hours. The use of cadmium in the nickel-plating bath is said to be advantageous, enabling less porous deposits of nickel to be formed.

F. J. B.

503. Electrical Resistance of the Electrode-Electrolyte Transition Layer. O. Scarpa and E. Denina.

Zeits. phys. Chem. 130. *pp*. 449–471, *Oct*., 1927. *In Italian*.

In some cases (Wehnelt's interruptor) this is very great; in others it seems insignificant. In general the formation of oxides, etc., effects changes in it, and it has important relations to electrochemical passivity and to supertension. The published results are, so far, defective; they are discussed. The authors distinguish between counter e.m.f. of polarisation as the fall of potential corresponding to the reversible discharge of the corresponding ions, and supertension as the greater tension which it is necessary to apply between the electrode and the electrolyte in order to cause visible electrolysis. This supertension is made up of three parts: (*a*) a fall of potential corresponding to the energy absorbed by the ultimate formation of compounds or solid solutions between the products of discharge of the ions and the substance of the electrode; (*b*) a fall of potential corresponding to the energy absorbed on the formation of gaseous bubbles; (*c*) a fall of potential corresponding to the energy expended in overcoming the electrical resistance at the surface of the electrode. They may be respectively called electrochemical, electrocapillary and ohmic supertension. It is difficult to disentangle them; but we can find the relative resistances $r' = \partial V/\partial i$. An experimental method is described for finding the impedance corresponding to the relative resistance. This impedance depends upon the sign of the polarisation of the electrode, the nature of the electrolyte, the nature of the electrode, the density of the current, the degree of polarisation of the electrode at the time, the history of the polarising current, the physical state of the polarised surface, the temperature and, probably, the pressure. Many of these items change progressively; and the indications are that a gaseous film is first formed upon the electrode and offers an initial increase in the resistance, but is more or less completely destroyed as visible electrolysis sets in. We thus have an initial ascent to a maximum in the value of the resistance, and changes in the curve of resistance and current density with lapse of time. Illustrative diagrams are included. A. D.

504. Dilution Law for Strong Electrolytes. R. T. Lattey. *Phil. Mag.* **4.** *pp.* 831–836, *Oct.*, 1927.

It was shown that the equation $\lambda_0 - \lambda = A/(B + V^{\frac{1}{2}})$, where A and B are constants peculiar to the solution in question, is applicable to a wide range of solutions. By aid of the data of Kohlrausch this formula was contrasted with that of Vogel and Ferguson, $\lambda_0 - \lambda = K/V^n$, and with that used by Debye and Hückel, $\lambda_0 - \lambda = A/V^{\frac{1}{2}} - AB/V$. The new formula was shown to yield results which agreed to within $\frac{1}{10}$%, the others broke down when V was between 20 and 50. F. J. B.

505. Theory of Electrolytic Dissociation. W. Nernst. *Z. El. Chem.* 33. *pp.* 428–431, *Oct.*, 1927. *Paper read before the Deut. Bunsen Gessell., Dresden, May*, 1927.

The author shows that the degree of dissociation can be determined in the sense of Arrhenius. That implies that the theory of Debye can only be valid within narrow limits, even for diluted electrolytes. Measurements by Nernst and Orthmann (Berlin Akad., p. 51, 1926, and p. 136, 1927) of the heat of dilution, determined within a few millionths of a degree, show negative values (instead of Debye's positive values), when the initial concentration c was about 0·3. If V denotes the heat of dissociation, α the degree of dissociation, B the positive heat of dilution in the sense of Debye, then $W_\infty = -V(1 - \alpha) + B\sqrt{c}$. The measurements support the formula, but they do not admit of determining more than the product $V(1 - \alpha)$, not the factors, even when B, which presumes a slight association, is known. This product should decrease as the temperature rises, because the true electrolyte dissociation then increases. The measurements of the change of the degree of dissociation with dissociation have been made by Naudé for alkali nitrates and chlorides. Hückel is criticised, and it is concluded that the influence of the electrostatic attraction of the ions upon the osmotic pressure is smaller than was assumed, owing to the appreciable association which is determined in two ways. H. B.

506. Heat of Dilution of Some Electrolytes within the Range of the Debye-Hückel Theory. E. W. Lange and G. Messner. *Z. El. Chem.* 33. *pp.* 431–440, *Oct.*, 1927. *Paper read before the Deut. Bunsen Gessell., Dresden, May*, 1927.

The energy of change on dilution will be negative or positive according as the negative energy of separating the ions or the positive increase in the heat of hydration predominates. In the case of water as solvent of electrolytes the latter component is the greater at high dilution. The experiments are made in an adiabatic differential calorimeter with the aid of many iron-constantan thermocouples (wires 13 mm. long, 0·5 mm. in diameter). As there is adsorption of the salt by the glass walls of the calorimeter, the glass surface was in some experiments increased to three times its value by the aid of powdered glass; the observed heat of adsorption did not change. The experiments with alkali salts and the sulphates of calcium and magnesium and calcium nitrate at initial concentration of N/100 and less confirm the theory of Debye and Hückel as to the positive character of the heat of solution. But the values observed were all smaller than those calculated for the alkali halides, and larger than those calculated for the divalent ions. It is noted that Nernst had acknowledged that, at high dilution, the heat of solution would essentially depend upon the electrostatic forces. An addendum deals with the change of the specific heat with concentration. H. B.